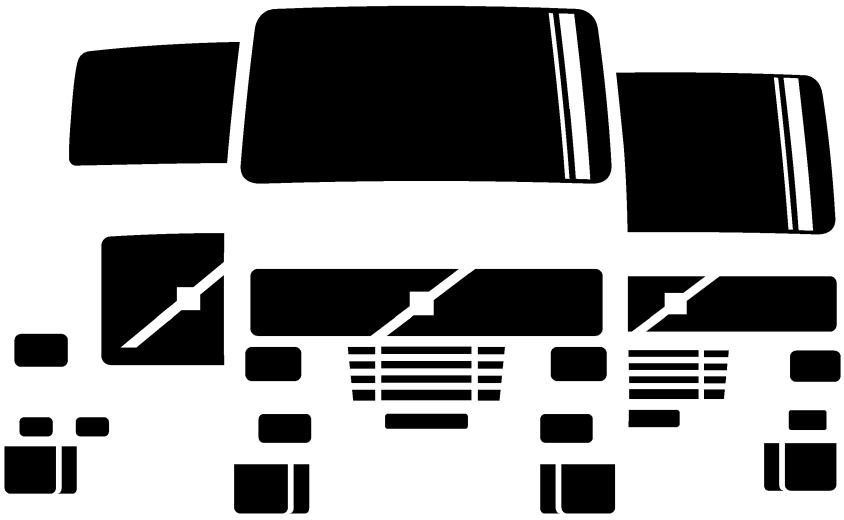
Service Manual
Trucks

Group **30**

Electrical General

VN,VHD VERSION2

From build date 11.2002



PV776-20180512

VOLVO

Foreword

The descriptions and service procedures contained in this manual are based on designs and methods studies carried out up to May 2007.

The products are under continuous development. Vehicles and components produced after the above date may therefore have different specifications and repair methods. When this is believed to have a significant bearing on this manual, supplementary service bulletins will be issued to cover the changes.

The new edition of this manual will update the changes.

In service procedures where the title incorporates an operation number, this is a reference to an V.S.T. (Volvo Standard Times).

Service procedures which do not include an operation number in the title are for general information and no reference is made to an V.S.T.

Each section of this manual contains specific safety information and warnings which must be reviewed before performing any procedure. If a printed copy of a procedure is made, be sure to also make a printed copy of the safety information and warnings that relate to that procedure. The following levels of observations, cautions and warnings are used in this Service Documentation:

Note: Indicates a procedure, practice, or condition that must be followed in order to have the vehicle or component function in the manner intended.

Caution: Indicates an unsafe practice where damage to the product could occur.

Warning: Indicates an unsafe practice where personal injury or severe damage to the product could occur.

Danger: Indicates an unsafe practice where serious personal injury or death could occur.

Volvo Trucks North America, Inc.
Greensboro, NC USA

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Contents

General

General Information

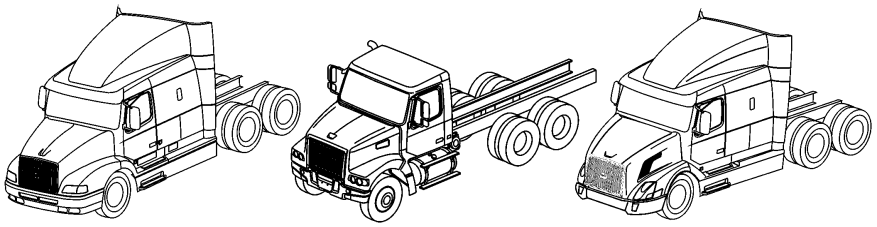

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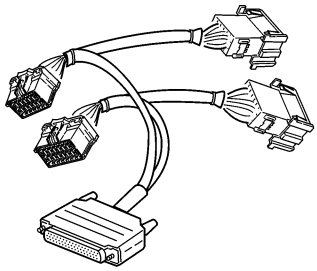
Fig. 1: VNM, VHD and VNL Models

This information covers electrical features of VN and VHD vehicles built from November 2002. It includes information about major cab electrical components, circuit types, controls, connectors and the tools commonly used for maintenance.

For vehicle-specific electrical wiring, refer to the VN/VHD VERSION2 electrical schematics in Group 37.

Tools

Special tools



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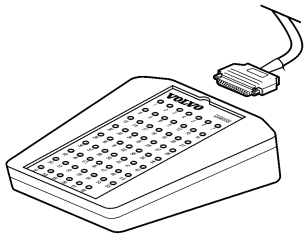

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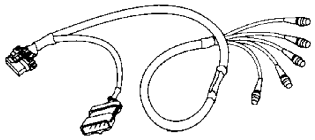
Breakout box



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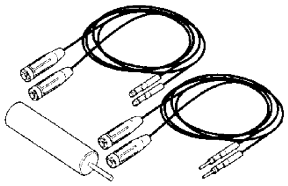
5–pin Breakout Harness



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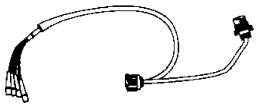
JAE Terminal Removal and Probe Kit



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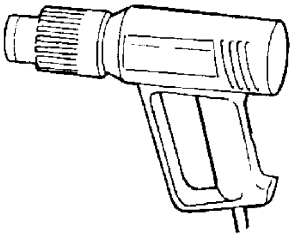
4–pin Breakout Harness



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Heat Gun

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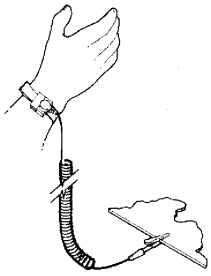
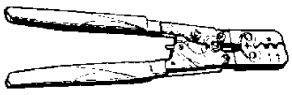
Fuse Puller Tool



BT-8639-B

Anti-Static Wrist Strap



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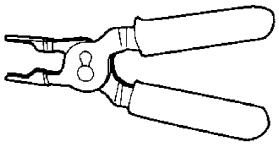

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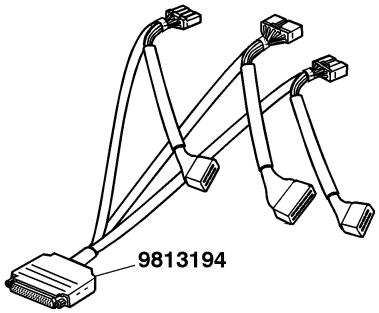
Relay Puller Tool



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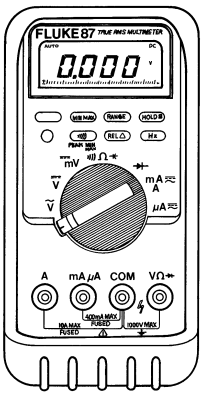
Adapter



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Multimeter

Design and Function

Electrical General

Typical Circuit Components

Wiring Harnesses, Wires & Connectors

Each circuit uses a wire of a specific size, based on the current demands for that circuit. The circuit number is stamped into the insulation every 76 mm (3 in.). This aids in proper connections and simplifies circuit tracing.

Black, numbered wires are fused, powered circuits. White wires are ground. Red wires are “hot” at all times and protected by fusible links. Multi-colored wire harnesses may be used as interfaces to some components; the definition of those multi-colored wires varies by component.

Some wires are grouped together and encased in a split plastic casing or braided tubing called a conduit.

This grouping of wires is called a harness. Major wiring harnesses are joined by using multiple plug and receptacle connectors.

Each harness or wire must be held securely in place by clips or other holding devices to prevent chafing of the insulation.

Terminals used throughout the system are Deutsch, Amp, JAE, KOSTAL and Packard.

Wiring Schematics

The wiring schematics for VN/VHD series vehicles are found in “VN/VHD VERSION2 Electrical Schematics, Group 37.” These schematics are continuously updated to provide detailed, vehicle-specific wiring information. Detailed instructions for schematic use is included in these binders. The schematics feature:

- Single circuit format
- Illustrated location of connectors on the vehicle
- Connector cavity, circuit and function details
- Fuse numbers
- Wire numbers
- Splice details
- Vehicle variant details

Simplified schematics are sometimes used in manuals and bulletins to help explain component design and function features or to clarify troubleshooting instructions. These simplified schematics do not offer the level of detail needed for vehicle troubleshooting, nor are they updated regularly. Always use the schematics found in “VN/VHD VERSION2 Electrical Schematics, Group 37” for the most current information.

Circuit Protection

To protect wiring and equipment from overloads, circuit protectors, such as fuses, are used. Circuit breakers and fusible links are also used.

CAUTION

Failure to use proper circuit protection devices in the vehicle can result in damage to the vehicle and its components. Replace blown fuses only with fuses of the same rating. Replace fusible links only with proper replacement parts of the exact gauge and length. Failure to use proper circuit protection could overload the circuit, causing severe damage to the vehicle.

Fuses

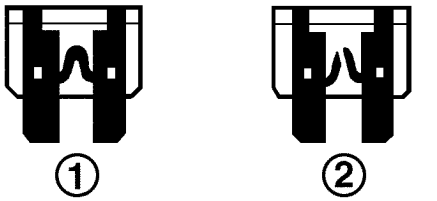

Fig. 2: Blade-type Fuses

1 Good fuse
2 Blown fuse

The most common protector in the vehicle circuit is a fuse. A fuse consists of a fine wire or strip of metal inside a glass tube or, more commonly, in a plastic housing. The strip melts and interrupts the flow of current in the circuit when there is an overload caused by an unwanted short or ground. The fuse is designed to melt before the wiring or electrical components in a circuit can be damaged. Naturally, the cause must be located or the new fuse will also blow. Since different circuits handle different amounts of current, fuses of various ratings are used. Be sure to replace a blown fuse with a fuse of the same rating.

The VN/VHD vehicles use maxi-fuses, which are designed for a larger amount of current than a regular fuse. Mini-fuses are also used. They are smaller in size, but their current ratings are the same as ATO blade-type fuses.

Fusible Links

Fusible links are used to protect high-current circuits against current overload when there is a short to ground. The fusible link is a short length of wire that is smaller in gauge than the wire in the protected circuit. In the event of an overload the fusible link will melt, breaking the circuit and preventing damage to the electrical system. If a fusible link does open, special attention must be paid to finding and repairing the cause.

Fusible links are used in two locations: two are at the starter motor on the positive side feeding the cab main power studs, and one is from ground on the starter motor to engine ground. The fusible links on the positive side are 10 gauge cables 120 mm (4.72 in.) in length. On the ground side, it is an 8 gauge cable.

Diodes

Diodes are used on many of the vehicle's circuits to protect and isolate them from voltage surges, which can occur when a circuit is turned off. Diodes allow voltage to flow in one direction only, like a one-way check valve.

Circuit Breakers

Circuit breakers are optional equipment. SAE Type 2 circuit breakers are the only type of circuit breakers approved, as options, for use in VN/VHD vehicles. SAE Type 1 circuit breakers are used in some lighting circuits as suggested by federal regulations. They may be used on accessory and ignition circuits only. Circuit breakers protect a circuit from overload. When an overload (high current flow) occurs in a circuit, a bimetallic strip in the breaker is heated. This opens its contact, temporarily breaking the circuit. When this bimetallic strip cools down, it remakes the contact.

Type 2 circuit breakers are opened by current overload and remain open as long as the power is on. A Type 2 circuit breaker keeps the bimetallic strip hot after tripping by diverting a small amount of current through a small coil of resistance wire. If power to the circuit breaker is switched off long enough for the bimetallic strip and resistance wire to cool down, the breaker will automatically reset.

Type 1 circuit breakers are automatic resetting circuit breakers which are cycling or continuously self-resetting units which are opened by overcurrent.

When any circuit breaker trips, it should be viewed as an indication of a possible fault in the circuit. Every effort should be made to identify and correct the fault if one exists.

Switches and Relays

Circuit controls are switches or relays. Switches are usually at the beginning of a circuit but can be used to control a ground path. Relays are remotely controlled switches. They use a low current signal through a coil to control larger currents conducted through their contacts.

VN Series vehicle circuits also include micro-relays. The micro-relay is smaller in size than a conventional relay, and the pin arrangement is different (see illustration).

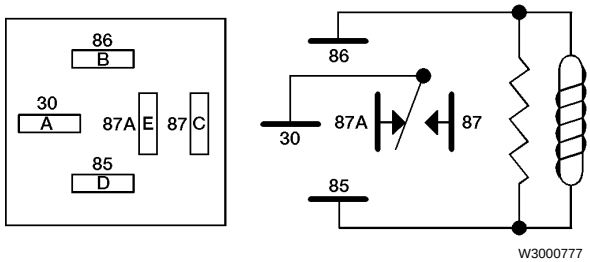

Fig. 3: Relay Pin Arrangement and Schematic

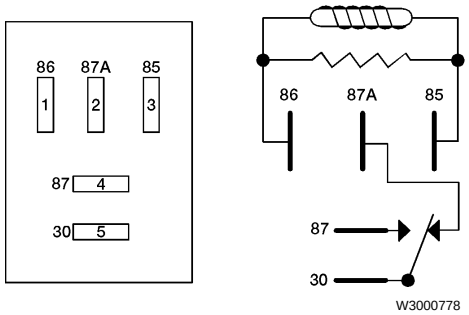

Fig. 4: Micro-relay Pin Arrangement and Schematic

Note: Relays are shown from insertion-side view.

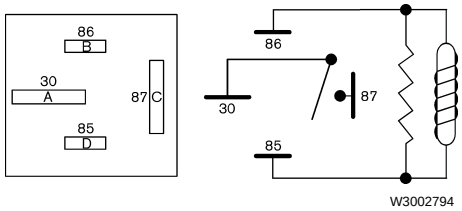

Fig. 5: Power Relay Pin Arrangement and Schematic

Sensors and Senders

Many electronic signals used by ECUs and the instrument cluster are supplied by sensors and senders. A sensor or sender sends a signal to a control unit, or to the microprocessor in the instrument cluster. Sensors used in the vehicle system include the vehicle speed sensor, the throttle position sensor and Anti-lock Brake System (ABS) wheel speed sensors.

The vehicle speed sensor is mounted in the transmission and reads the movement of the teeth on the output shaft. It is of an inductive type and sends a fluctuating (sinusoidal) signal to the engine ECU.

The fuel sender, mounted in the fuel tank, transmits the fuel level to the instrument cluster. The resistance changes with the fuel level.

An Anti-lock Brake System (ABS) wheel speed sensor is mounted in each monitored wheel. As the wheel spins, the sensor sends a fluctuating signal to the ABS ECU, which the ECU interprets as wheel speed.

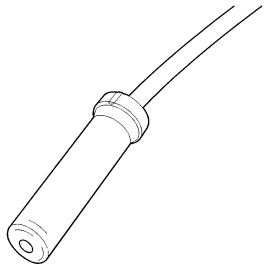

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Fig. 6: Anti-lock Brake Wheel Speed Sensor

VN and VHD vehicles are equipped with combination sensors that can measure both pressure and temperature of certain engine functions.

The exhaust pyrometer sensor measures exhaust temperature and this is a direct input into the instrument cluster. The pyrometer is a thermocouple, the voltage potential (mV) changes with temperature.

The transmission and axle oil temperature sensor information are directly input into the instrument cluster and displayed as separate gauges in the cluster. The resistance changes as the oil temperature changes.

The turbo boost sensor, for example, measures both the temperature and the pressure of the boost air entering the intake manifold.

- The pressure portion of the sensor is a capacitive type that sends a measured voltage signal to the EECU, which interprets this pressure and adjusts engine functions accordingly.
- The temperature portion of the sensor is a thermistor type that sends a measured resistive value to the EECU, which interprets this temperature and adjusts engine functions accordingly.

The engines oil temperature/pressure sensor functions identically to the way the turbo boost sensor works. However, the engine ECU gets the oil information first, then passes the information on to the Instrument Cluster via the two vehicle data links (J1939 and J1587/J1708).

An ambient air temperature sensor is mounted on the engine compartment side of the hood. It is a thermistor type, its resistance changes with the outside temperature and this information is a direct input to the instrument cluster.

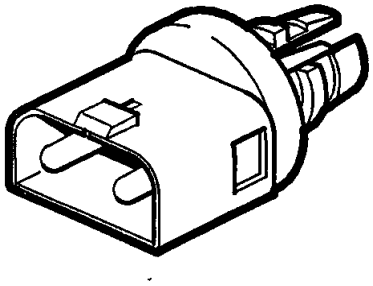

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Fig. 7: Ambient Air Temperature Sensor

Air Pressure Transducers

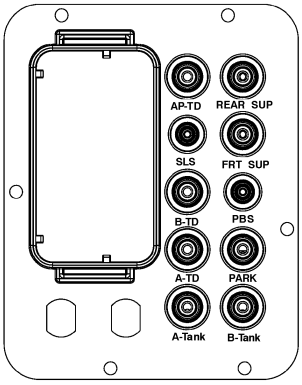

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Fig. 8: Air Pressure Transducer Layout

An air pressure transducer is a device that converts a physical measurement (air pressure) into an electrical signal. All of the transducers are mounted in the cab pass-through. The transducers are 3–pin and the pressure switches are 2–pin. All of the transducers control separate gauges in the instrument cluster.

Data Link Communication

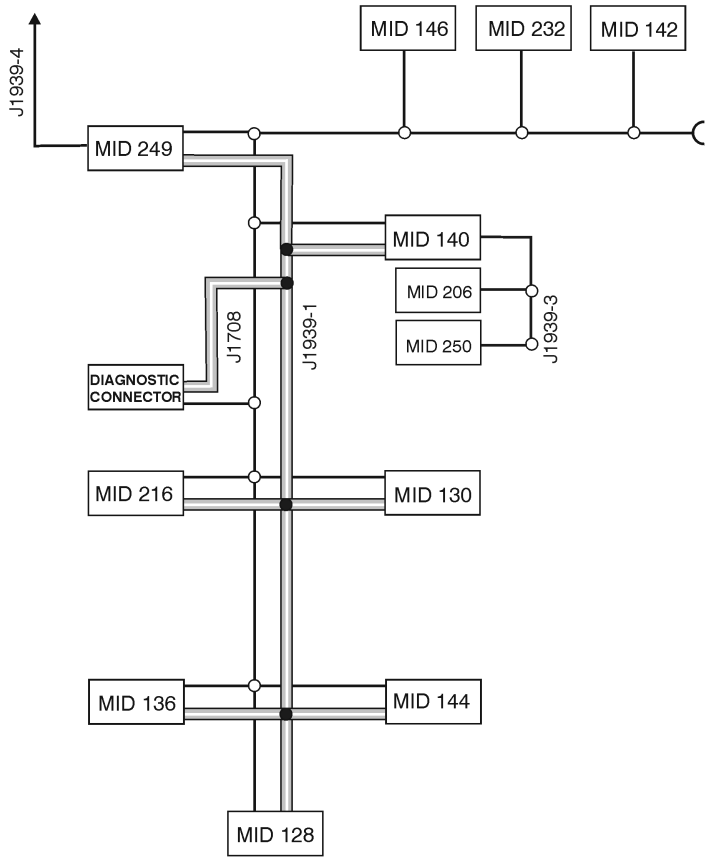
General

Communication between the different ECUs takes place via the two data links: the J1939 control data link and the J1587/1708 information data link.

The diagram shows how the control units, the diagnostic connector, and the instrument cluster are connected in principle.

The instrument cluster, the engine ECU and **the diagnostic connector** are always included in the system. The system may include other control units, depending on the vehicle type, engine type and optional equipment.

An overview of data link communication follows. For complete information on data link communications, see "*Vehicle Electronics, Design and Function*" in group 03.



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MID 128	Engine control unit	**MID 232**	Airbag (SRS), control unit	**J1939–3**	Section of SAE J1939 under the instrument cluster
MID 136	Anti-lock Brake (ABS) control unit	**MID 249**	Body builder module	**J1939–4**	Section of SAE J1939 under the bodybuilder control unit
MID 140	Instrument cluster	**MID 250**	Steering Wheel Module		
MID 142	Satellite Communications	**J1939–1**	Main network SAE J1939		
MID 144	Vehicle control unit (VECU)	**J1939–2**	Section of SAE J1939 under the vehicle control unit		
MID 146	Climate control unit				
MID 206	Radio				
MID 216	Lighting control module (LCM)				

SAE J1939 Control Data Link

The system's **control signals** are sent via this link.

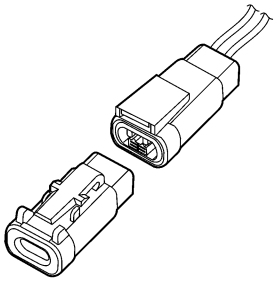
The J1939 link is very fast, operating at 250,000 bits per second. This operating speed allows the system to function more effectively and adapt quickly to changing conditions and vehicle requirements.

The link complies with SAE standards, and consists of two twisted wires: a green wire (407) and a yellow wire (406). The twisted wire set (40 turns per meter) is used to protect the link from electrical interference.

CAUTION

Follow Volvo's instructions on "Data Link Troubleshooting and Repair" in group 371 if repairs are needed to Data Link wires. These wires are used for the transmission of data for diagnostic messages and gauges. Improper repair can cause these functions to fail.

Terminating Resistor



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Terminating Resistor, 2–pin

Terminating resistors are wired into each end of the J1939 data link. One is located in the TEC center near the VECU and the other near the engine ECU. On Volvo engines, the terminating resistor at the engine ECU end is located inside the EECU.

Only two terminating resistors are used in a vehicle. Never install three in one truck. If more than two terminating resistors exist in the J1939 circuit, damage to the ECU electronics can occur over time. You can easily check to see if you have two resistors by measuring the resistance between circuits 406 and 407 with the ignition OFF. The correct resistance is 60Ω.

The purpose of these resistors is to prevent data link signal reflections. They must remain connected for the system to function properly.

SAE J1587/1708 Information Data Link

Information and diagnostic signals are sent via this link. In some cases, the link also functions as a "backup" should the J1939 control data link fail to function.

SAE J1587/1708 is a standard that specifies hardware and a databus speed of 9600 bits per second. SAE J1587/1708 is a protocol that provides a standard method for exchanging information between microprocessors.

The J1587/1708 link consists of two wires (400 and 401) that are twisted around each other approx. 30 turns per meter. The twisted-pair wires are to protect the link against electrical interference.

CAUTION

If a circuit must be added to the electrical system, and will carry high currents or frequencies, route it in a location AWAY from wires 400 and 401 to prevent mutual inductance from interfering with data link functions.

CAUTION

Follow Volvo's instructions on "Data Link Troubleshooting and Repair" in group 371 if repairs are needed to Data Link wires. These wires are used for the transmission of data for diagnostic messages and gauges. Improper repair can cause these functions to fail.

Diagnostic Connector

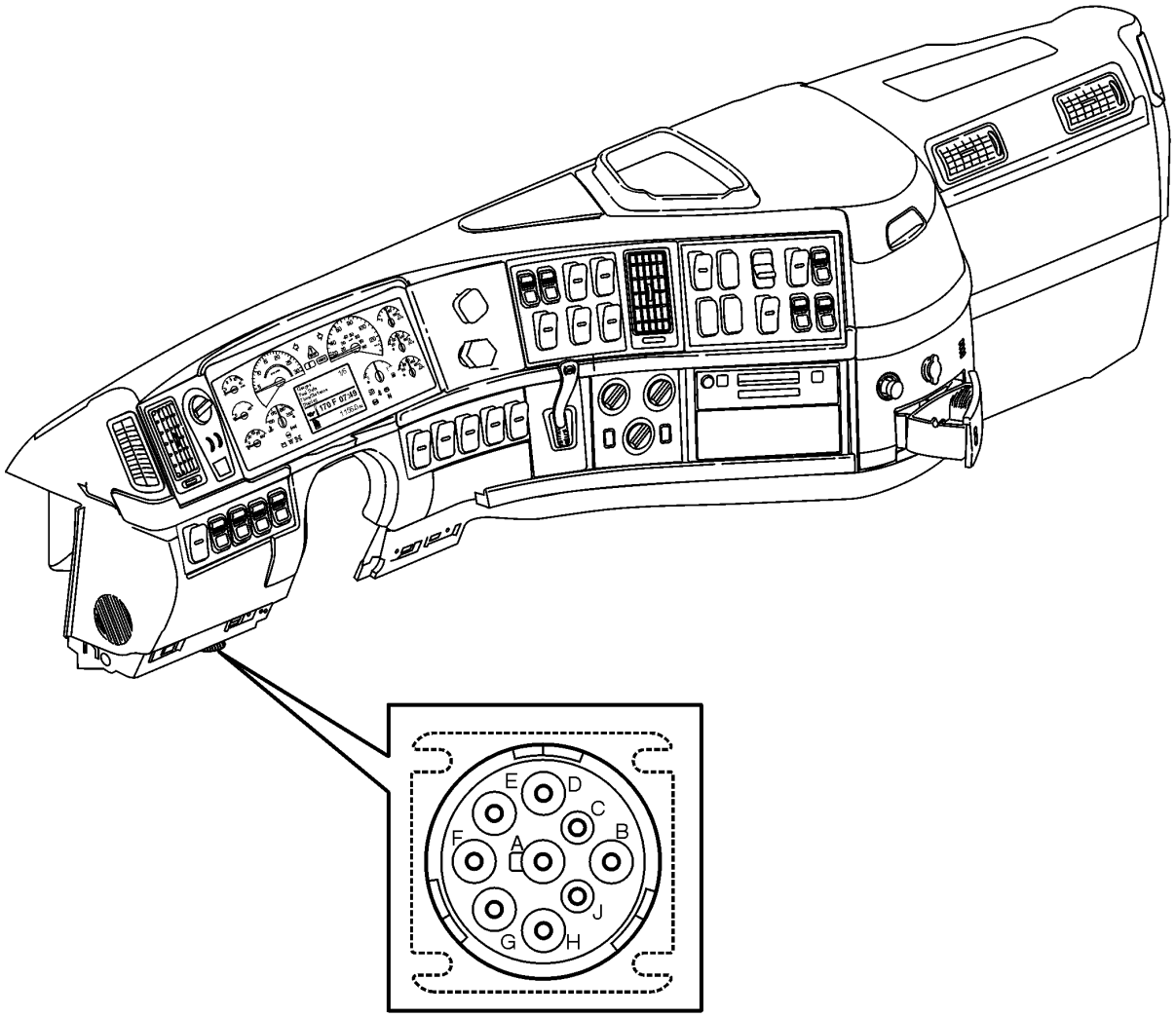


Fig. 9: Diagnostic Connector

9–pin Diagnostic Connector	
Cavity Position	**Circuit Description**
A	0Z (B-)
B	402 (B+)
C	406C (CAN_H, yellow)
D	407C (CAN_L, green)
E	not used
F	400G (SAE A, 1708)
G	401G (SAE B, 1708)
H	not used
J	196DR (Ignition)

The diagnostic connector is a round connector located in the driver's side kick panel. The diagnostic connector is connected to the J1587/1708 information link and gives the system a way to communicate with an external PC or diagnostic tool.

With a PC or diagnostic tool connected, error codes can be read from all the control units. This is important in fault tracing to carry out basic checks of all the vital parts of the vehicle's electronics.

Some programming can also be done via the diagnostic connector.

The standard diagnostic connector is a 9–pin circular connector. The 9–pin connector connects to both the J1939 and J1587/1708 data links.

Electrical Power and Ground

Battery Power Supply

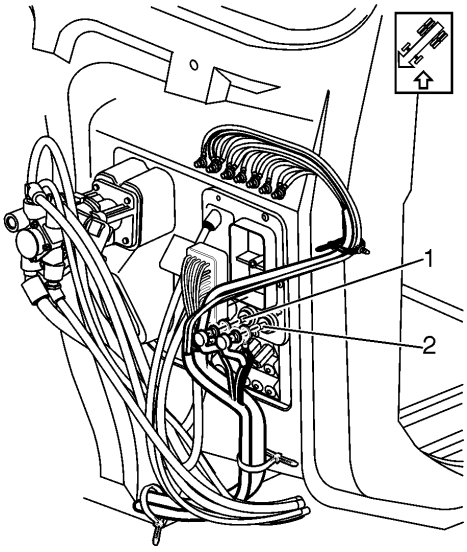


Fig. 10: Main Cab Electrical Power Studs (in cab pass-through)

1 Power Stud 1
2 Power Stud 2

Power is supplied from the batteries to the starter solenoid, then from the starter solenoid battery post via wires 1A–A and 1B–A. (Note that each of these wires contains a fusible link.) Wire 1B feeds cab main power stud 1, and 1A feeds cab main power stud 2.

CAUTION

The ignition and battery expansion blocks were designed for plug-in harnesses or fuses only. DO NOT plug ATO-size fuses or circuit breakers into either expansion block. These devices will short the power point to the ground bus.

CAUTION

Failure to properly install additional electrical components may adversely affect the operation of the vehicle, including the engine, electrical charging system, truck body, stereo system and the driver information systems. See “Add-on Electrical Equipment” page 66 for more information.

- Power stud 1 feeds power wire 1, which delivers power to maxi-fuses MFA2–8 in the power module. These maxi-fuses supply power to various fuses and expansion blocks. The battery power expansion block is used to supply power to optional electrical accessories.
- Power stud 2 feeds wire 1V, which delivers power through a splice to the maxi-fuses MFB1 and 3–8 in the power module. Battery power is also supplied to the ignition switch through this circuit.

Accessory Power Supply

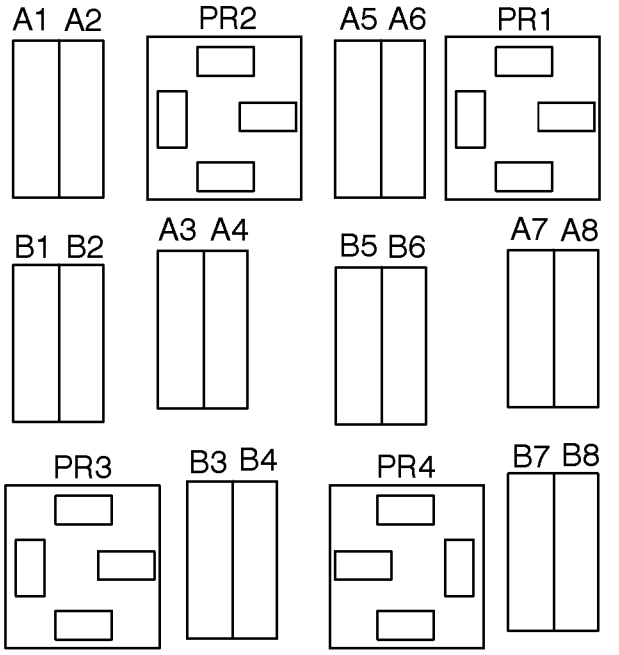


Fig. 11: Accessory Power Relay, PR4

- Constant battery power is supplied to the ignition switch and Accessory Power Relay. See “Battery Power Supply” page 17.
- When the ignition switch is switched to the ACCESSORY position, the 195 wire energizes the **Accessory Power Relay**, PR4 in the power module. The relay supplies power to wire 195A for the bus bar for Accessory fuses F1–F7.
- The ground for the Accessory Power Relay PR4, is spliced into the ground for the Battery Power relay, which is connected to splice pack X0D, where it continues through the cab pass-through to ground XG4.

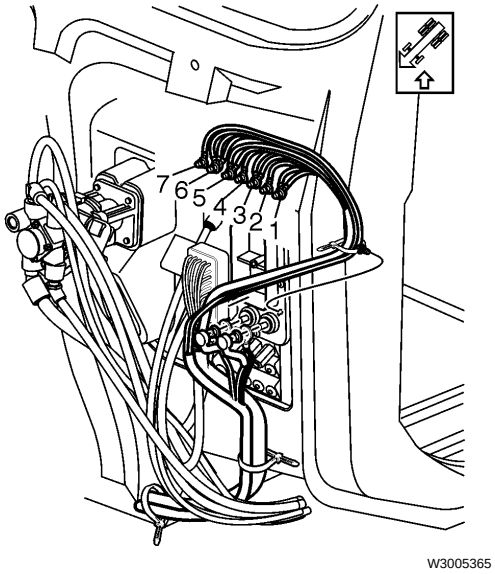


Fig. 12: Ground Studs

Ignition Power Supply

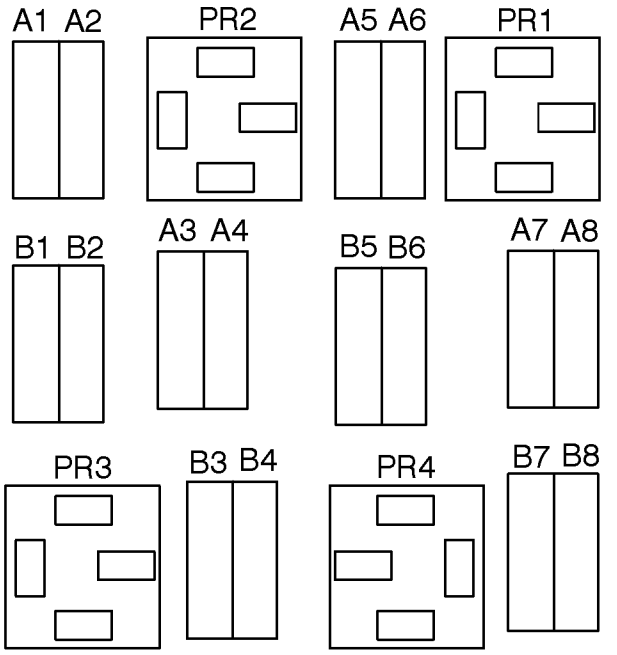


Fig. 13: Ignition Power Relays, PR2 and PR3

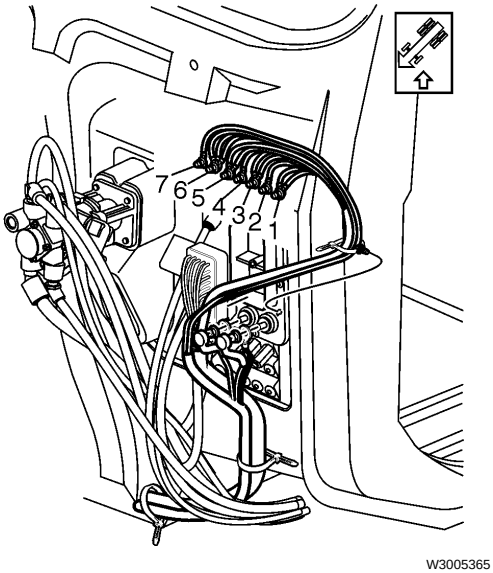


Fig. 14: Ground Studs

CAUTION

The ignition and battery expansion blocks were designed for plug-in harnesses or fuses only. DO NOT plug ATO-size fuses or circuit breakers into either expansion block. These devices will short the power point to the ground bus.

CAUTION

Failure to properly install additional electrical components may adversely affect the operation of the vehicle, including the engine, electrical charging system, truck body, stereo system and the driver information systems. See “Add-on Electrical Equipment” page 66 for more information.

- Constant battery power is supplied to the ignition switch and Ignition Power Relays. See “Battery Power Supply” page 17.
- When the ignition switch is turned to the ON position, the 196 wires energize the Ignition Power Relay Coils PR2 and PR3. The relay coils are grounded through the cab pass-through, at ground XG4.
- When energized, Ignition Power Relay PR2 supplies power to a mini-fuse bus bar. These mini-fuses in turn supply power to fuses F22–35.
- When energized, Ignition Power Relay PR3 supplies power to a mini-fuse bus bar. These mini-fuses in turn supply power to fuses F56–69.

System Ground

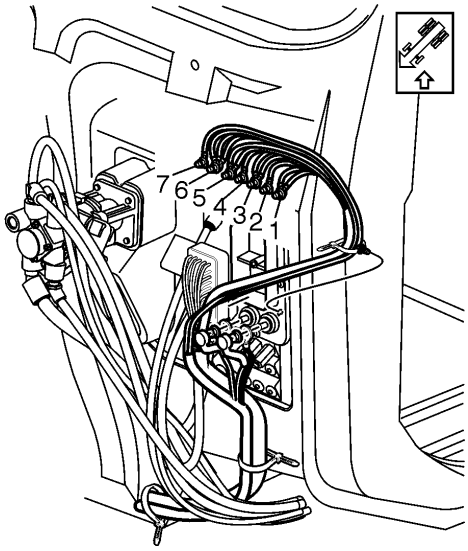


Fig. 15: Ground Studs

Cab ground studs are located in the engine compartment on the cab just above the cab pass-through. One ground stud is located in side the cab, near the climate unit. It is used for a grounding point when overlay harness are added. Torque for the ground studs is 10 ± 1.5 Nm (7.4 ± 1.1 ft-lb).

Electrical Pass-through for Cab Wiring

Cab Pass-Through

The cab cable pass-through is located on the left side of the bulkhead. The pass-through contains one 102 cavity connector which joins the inner and outer cable harnesses. All of the cab module grounds will pass through the cab at this interface.

The cab main power studs are located at the pass-through. Torque for the main power studs is 10 ± 2 Nm (7.4 ± 1.5 ft-lb).

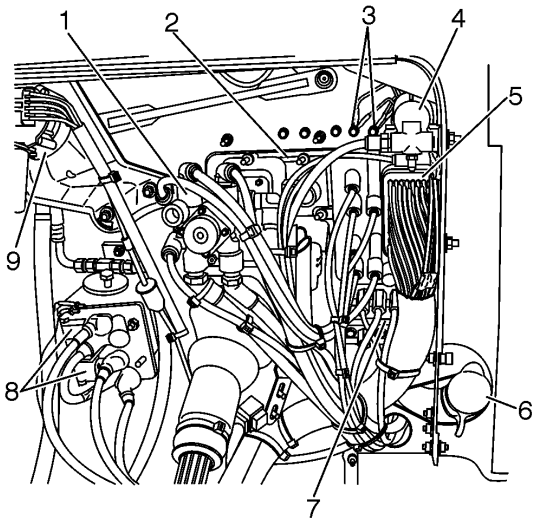
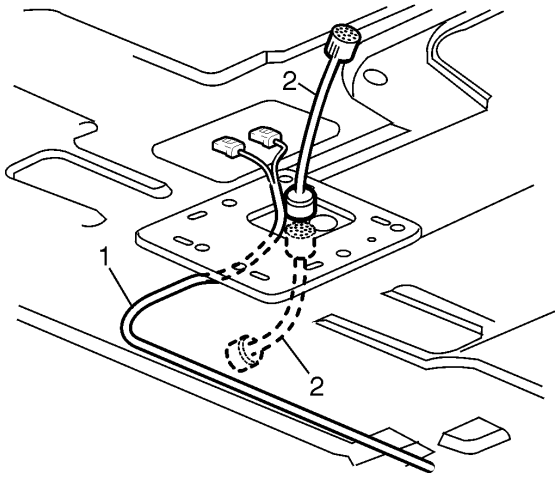


Fig. 16: Cab Pass-Through

1 Foot Valve
2 Pedal Carrier
3 Ground Studs
4 Air Governor
5 Chassis Harness
6 Windshield Washer Filler Neck
7 Pneumatic/Electrical Interface Plate
8 Pre-heater relay
9 Windshield Wiper Motor

Bodybuilder Pass-through

The Bodybuilder pass-through may be installed in VHD models. It is present only if the Bodybuilder prep kit has been installed. It is located in the center of the cab floor, between the seats, in the center console mounting plate.



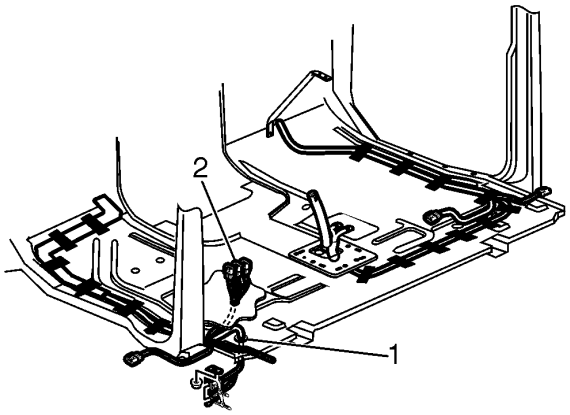
W3004417

Fig. 17: Bodybuilder Pass-through in Center of Cab Floor

1 Bodybuilder Harness from A-pillar
2 Bodybuilder Pass-through Wiring

Transmission Pass-through

The Transmission pass-through is installed on vehicles equipped with an electrical/electronic transmission. It is located in the cab floor, near the right rear of the driver seat.

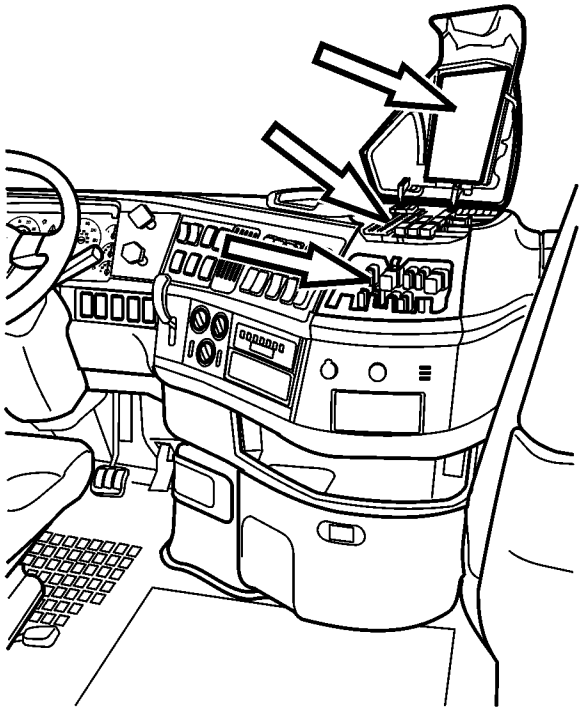


W3005696

Fig. 18: Transmission Pass-through

1 Transmission Pass-through
2 Power seat and transmission connectors

Fuse and Relay Locations



W3005285

Fig. 19: TEC in Center Dash

The vehicle's instrumentation, gauges and other electrically controlled parts are wired through the Truck Electrical Center (TEC). The TEC is located in the center of the dash, just above the engine cover.

The vehicle has two electrical centers, one located in the middle of the dash under the top cover, and the other under the front cover. The electrical center underneath the front cover is the power module and it feeds the relays to the electrical center under the top cover.

Located just below the fuse/relay panel are the following modules: Vehicle ECU/Bodybuilder module, Light Control Module, Steering Wheel Module and Central Locking Module/relay.

Refer to the decal inside the TEC cover for vehicle's exact fuse locations and ratings. (Note that all fuses and relays may not be used in every vehicle.)

The TEC panel includes all maxi-fuses, mini-fuses, relays and micro-relays. Maxi-fuses are designed for larger amounts of current than regular fuses. The micro ISO relays are smaller in size than conventional relays, and the pin arrangement is different. Mini-fuses are also smaller in size, but the current rating is the same as ATO-size fuses.

Power Module

Note: Refer to the decal inside the power module cover (behind cupholder) for vehicle's exact fuse/relay descriptions and ratings.

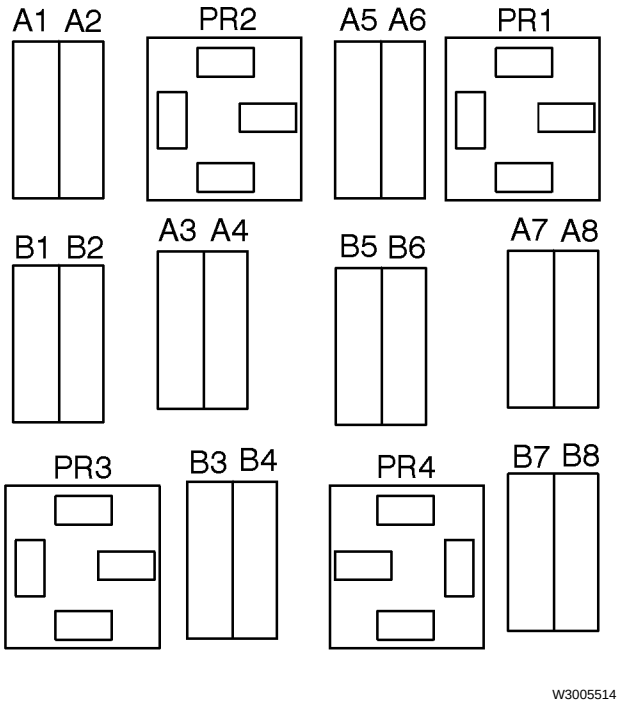


Fig. 20: Fuse and Relay Positions, Power Module

Fuse and Relay Positions, VN

Note: Refer to the decal inside the TEC cover for vehicle's exact fuse descriptions and ratings.

Note: 30A circuit breakers are installed in the following locations: F8, F10, F17, F36 and F38.

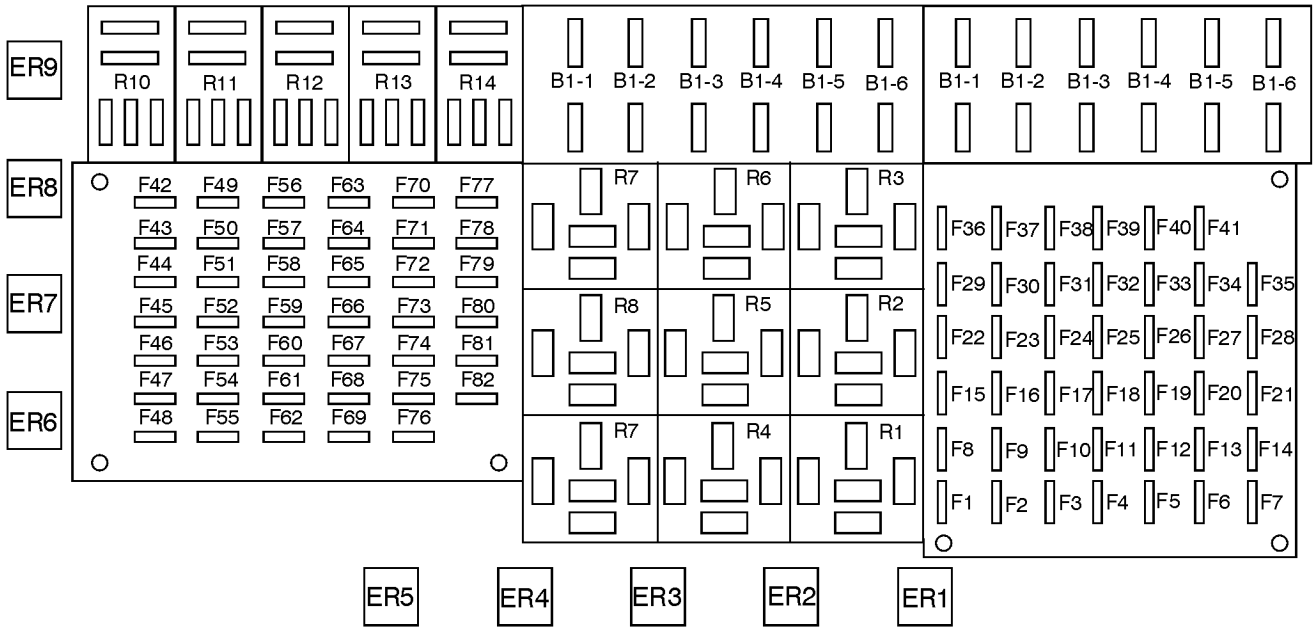


Fig. 21: Fuse and Relay Positions (in the top TEC panel), VN

Fuse and Relay Positions, VHD

Note: Refer to the decal inside the TEC cover for vehicle's exact fuse descriptions and ratings.

Note: 30A circuit breakers are installed in the following locations: F8, F10, F17, F36 and F38.

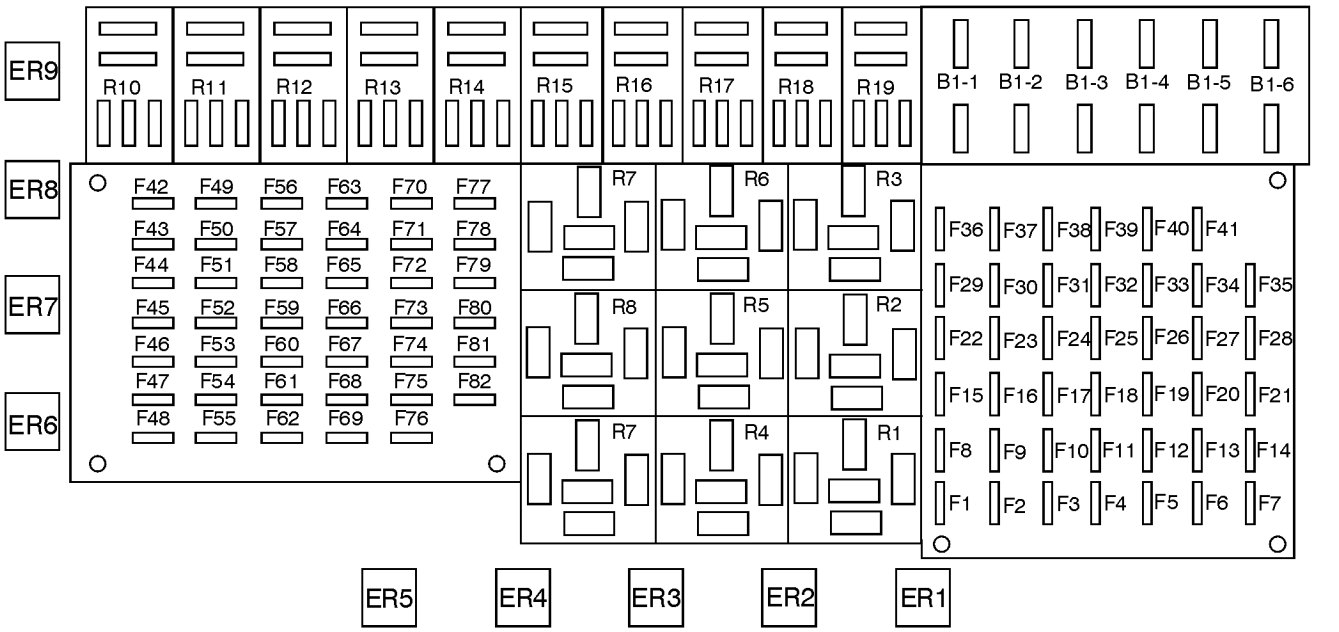


Fig. 22: Fuse and Relay Positions (in the top TEC panel), VHD

Switches and Controls

Dash Switches

All dash-mounted switches feature heavy duty terminals and locking mating connectors. Rocker switches have illuminated legends with embedded LEDs to indicate *ON* or *OFF* status of electrical devices.

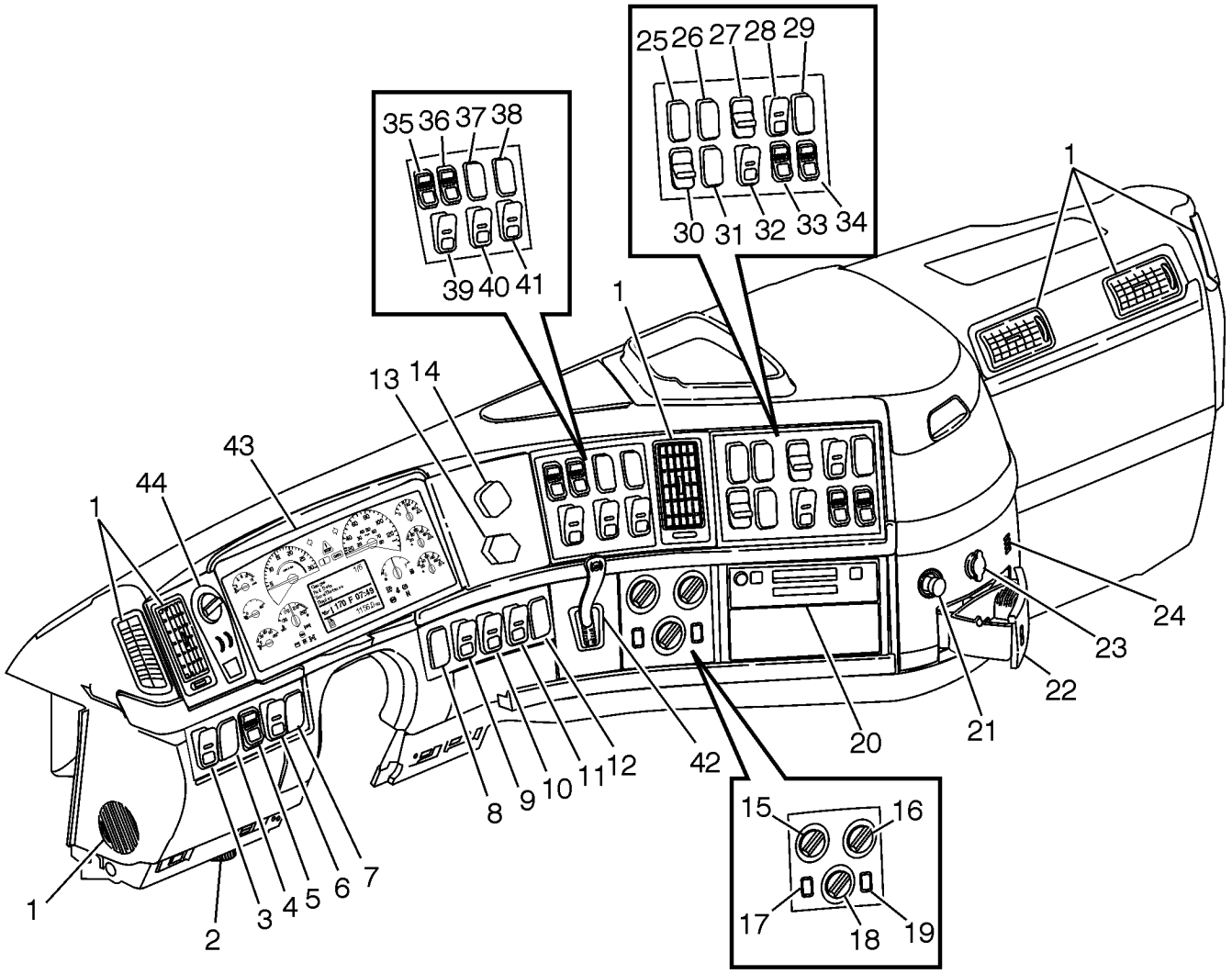


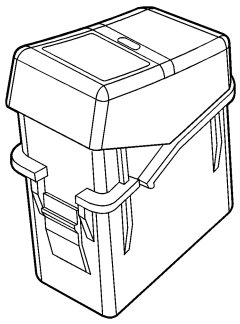
Fig. 23: Dash Switches, VN (VHD similar)

1 Air Vents
2 Diagnostic Connector
3 Back of Cab Light
4 Optional Switch (Open)
5 Power Take-off (PTO)
6 Overhead Bunk Light
7 Optional Switch (Open)
8 Optional Switch (Open)
9 Fuel Pressure (VED12 only)
10 Smoke Detector
11 Sleeper Fan Speed
12 Volvo Action Service
13 Trailer Air Supply
14 Tractor Parking Brake
15 Temperature Knob
16 Fan Speed
17 AC ON/ OFF
18 Air Distribution
19 Recirculation
20 Radio
21 Cigar Lighter
22 Ash tray
23 Auxiliary 12 V Power Outlet
24 Temperature Sensor
25 Optional Switch (Open)
26 Optional Switch (Open)
27 Engine Brake
28 Engine Brake Mode Select
29 Optional Switch (Open)
30 Marker Interrupt (Optional)
31 Optional Switch (Open)
32 Traction Control
33 Suspension Dump
34 5th Wheel Slide
35 Interwheel Differential Lock
36 Interaxle Differential Lock
37 Optional Switch (Open)
38 Optional Switch (Open)
39 Aux #1
40 Aux #2
41 Aux #3
42 Trailer Hand Brake Control
43 Instrument Cluster
44 Light Control Panel

Switch Logic Diagrams

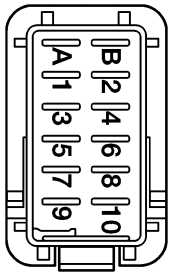
Note: Switches are illustrated from wire insertion-side view.

Back of Cab Lamp, Beacon Lamp



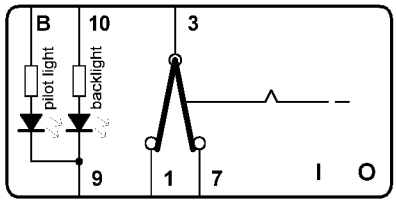
W3000579

Fig. 24: Switch



W3000577

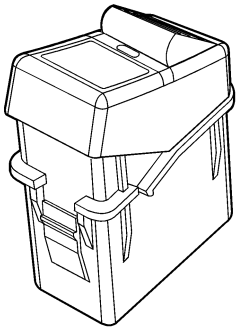
Fig. 25: Switch, Wire Insertion Side View



W3005452

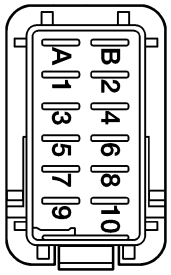
Fig. 26: Internal Switch Logic

Power Take Off, Suspension Dump, 5th Wheel Slide, Transmission Retarder, Interwheel Differential Lock and Interaxle Differential Lock



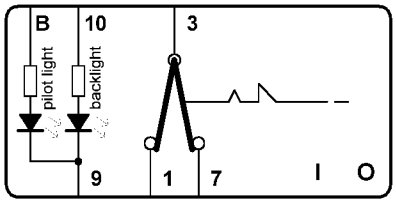
W3004415

Fig. 27: Switch



W3000577

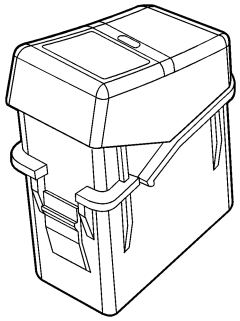
Fig. 28: Switch, Wire Insertion Side View



W3005454

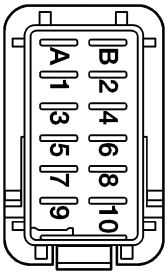
Fig. 29: Internal Switch Logic

Bunk Overhead Light, Sleeper Fan Speed



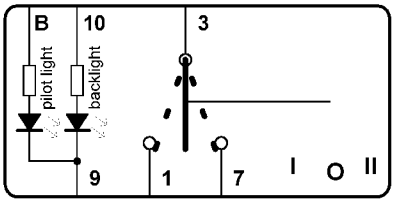
W3000579

Fig. 30: Switch



W3000577

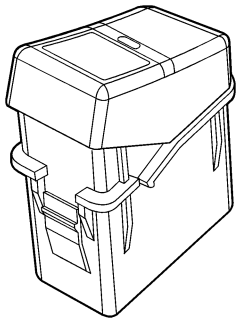
Fig. 31: Switch, Wire Insertion Side View



W3005458

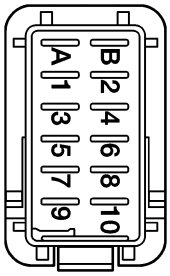
Fig. 32: Internal Switch Logic

Smoke Detector Disable, Traction Control Switch



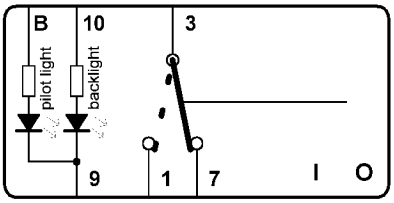
W3000579

Fig. 33: Switch



W3000577

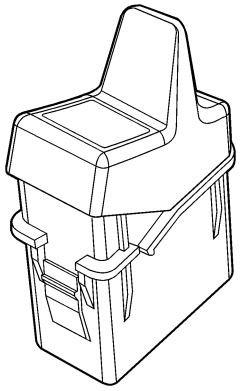
Fig. 34: Switch, Wire Insertion Side View



W3005453

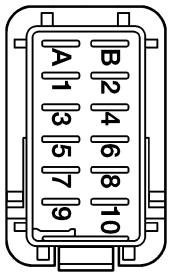
Fig. 35: Internal Switch Logic

Engine Brake



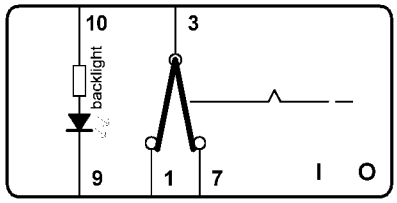
W3000578

Fig. 36: Switch



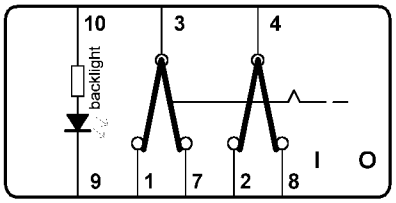
W3000577

Fig. 37: Switch, Wire Insertion Side View



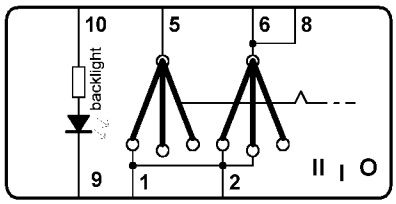
W3005455

Fig. 38: Internal Switch Logic



W3005461

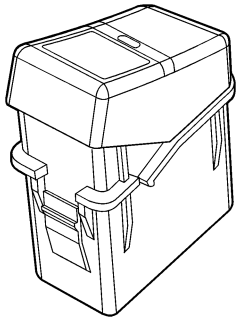
Fig. 39: Internal Switch Logic



W3005464

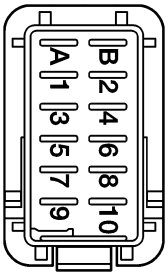
Fig. 40: Internal Switch Logic

Engine Brake Mode Select



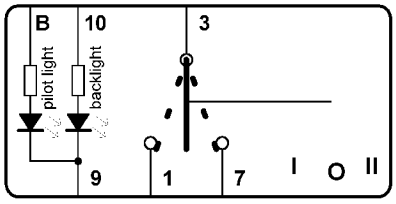
W3000579

Fig. 41: Switch



W3000577

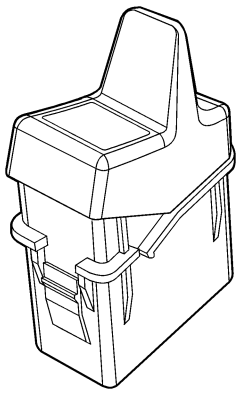
Fig. 42: Switch, Wire Insertion Side View



W3005458

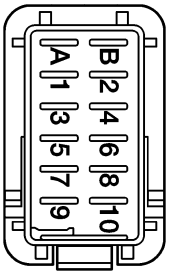
Fig. 43: Internal Switch Logic

Marker Interrupter, Headlight Interrupter Switch (optional)



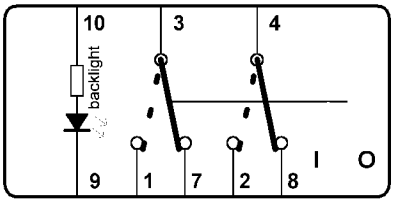
W3000578

Fig. 44: Switch



W3000577

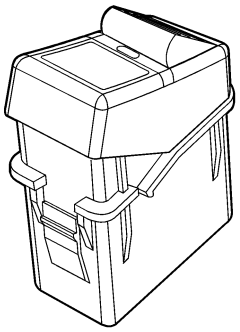
Fig. 45: Switch, Wire Insertion Side View



W3005462

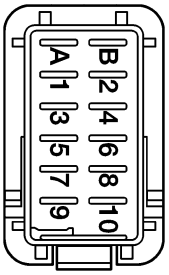
Fig. 46: Internal Switch Logic

Snow Plow Lamps



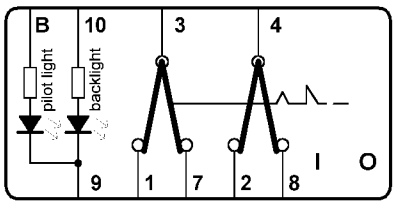
W3004415

Fig. 47: Switch



W3000577

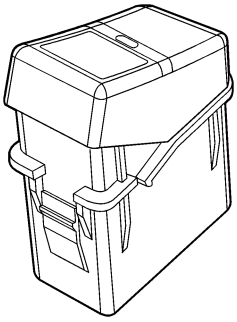
Fig. 48: Switch, Wire Insertion Side View



W3005460

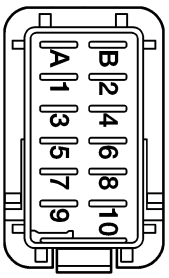
Fig. 49: Internal Switch Logic

Lift Axle Switches



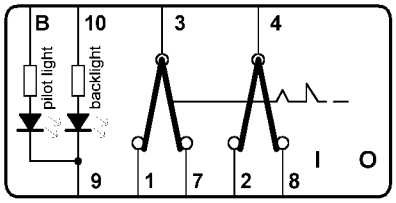
W3000579

Fig. 50: Switch



W3000577

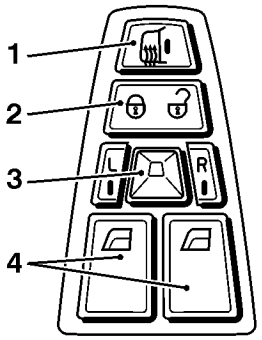
Fig. 51: Switch, Wire Insertion Side View



W3005460

Fig. 52: Internal Switch Logic

Door Switches



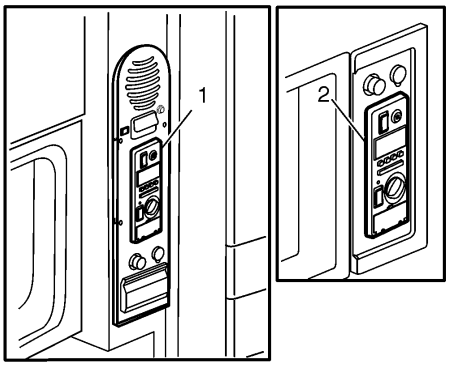
W8003087

Fig. 53: Switch on Driver's Door

1 Mirror Heat Switch
2 Door Lock/Unlock Switch
3 Mirror Control Switch
4 Power Window Switches

The passenger side may only include a window switch to control the right window.

Sleeper Control Panel (LECM)

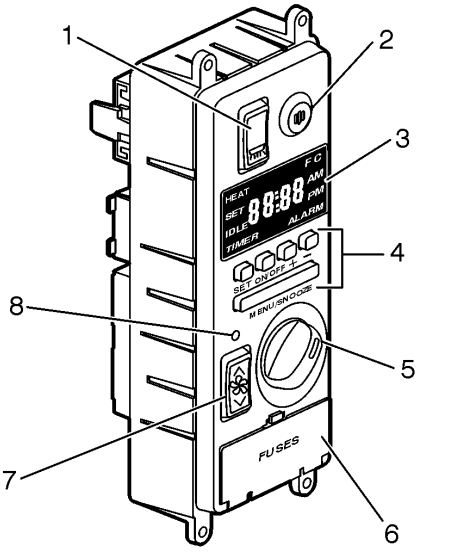


W3005273

1 Panel in VN 780
2 Panel in VN 430, 630, & 670

The Sleeper Control Panel or Living Environment Control Module (LECM) has six separate features that enhance the overall quality impression of the living environment. These features are as follows:

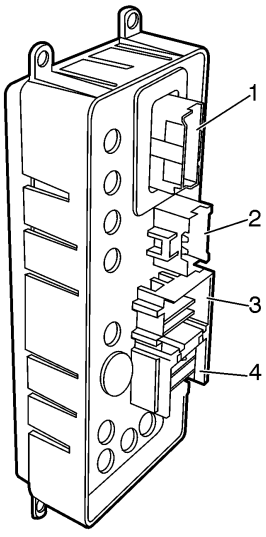
- Circuit protection for the sleeper 12 volt functions
- Electronic form of load shedding
- Auxiliary heating, venting and air conditioning (A-HVAC) controls
- Interior lighting control
- Parking heater controls
- Alarm clock



W3005163

Fig. 54: Sleeper Control Panel, front view

1 Overhead Lamp Switch
2 Speaker
3 Display Screen
4 Menu Control Buttons
5 Temperature Control Knob
6 Fuses
7 Fan Speed Control Switch
8 Fan ON LED/Load Shed Warning



W3005326

Fig. 55: Sleeper Control Panel, rear view

1 Connector A — 24–way Micro-Pack
2 Connector B — 8–way 280 Metric-Pack
3 Connector C — 12–way 280 Metric-Pack
4 Connector D — 12–way 280 Metric-Pack

Ignition Switch

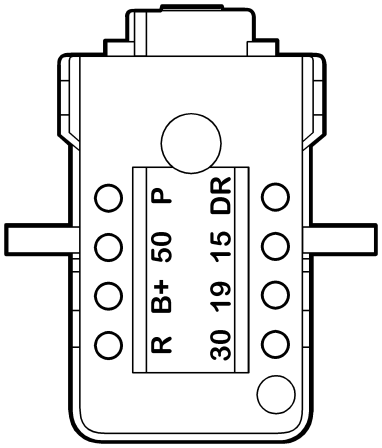


Fig. 56: Ignition Switch Connector Detail

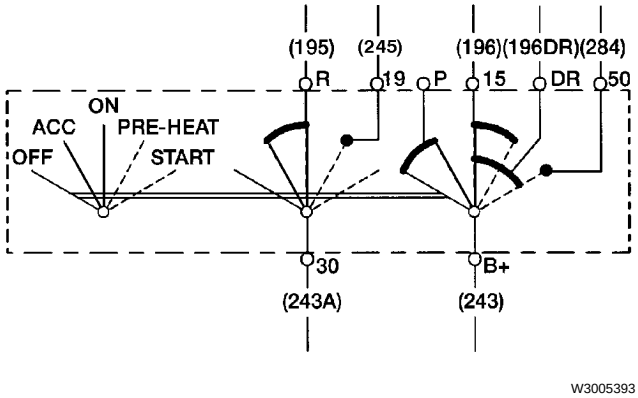


Fig. 57: Ignition Switch Logic Diagram

Note: Numbers inside parenthesis are circuit numbers.

The ignition switch is mounted in the key lock assembly. It is a single switch of a double contact design – there is no separate start button. The chart below gives the pin and circuit description.

Note: The ignition switch and door locks use the same laser cut key. Laser cut keys require special key cutting equipment that most locksmiths will not have. Replacement keys can be ordered from Volvo by key code.

Pin	Circuit No.	Description
R	195	To accessory power relay coil
B+	243	+12V Battery supply
50	284	Starter relay feed
P		Not used
30	243A	+12V Battery supply
19	245	Preheat request
15	196	To ignition power relay coil
DR	196DR	Ignition feed

Stalk Switches

Wiper/Washer Switch

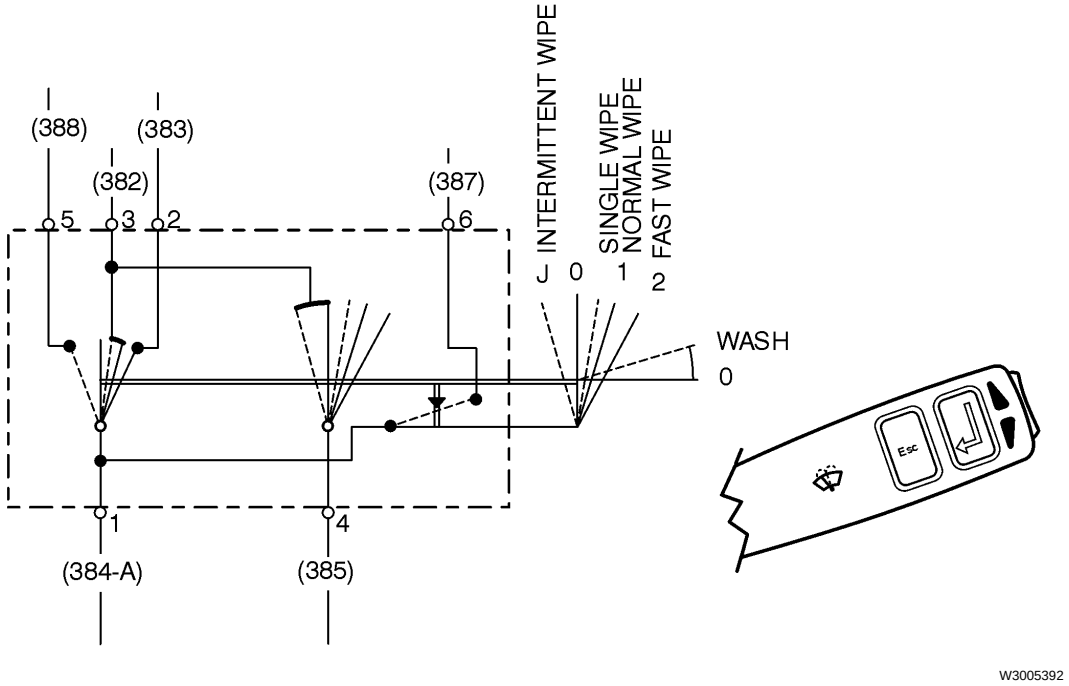


Fig. 58: Wiper/Washer Switch

Note: Numbers inside parenthesis are circuit numbers.

Controls for the windshield wiper/washer are on the stalk on the right-hand side of the steering column.

Intermittent wipers are pre-set to make a single sweep every 10 seconds. The interval can be set to between 1 and 10 seconds by moving the wiper stalk to the intermittent position, then to off, then to intermittent again when another sweep is desired.

For more complete information on the wiper/washer system, including troubleshooting and service procedures, see “Windshield Wiper System” service information in Group 36.

Wiper/washer Switch Connector		
Pin	Circuit No.	Description
1	384-A	12V Supply to Wiper Switch
2	383	High Speed Wiper
3	382	Low Speed Wiper
4	385	LCM Input Signal (wiper motor active)
5	388	12V Input to LCM (intermittent function)
6	387	12V Supply to Washer Motor

Graphic Display Switch

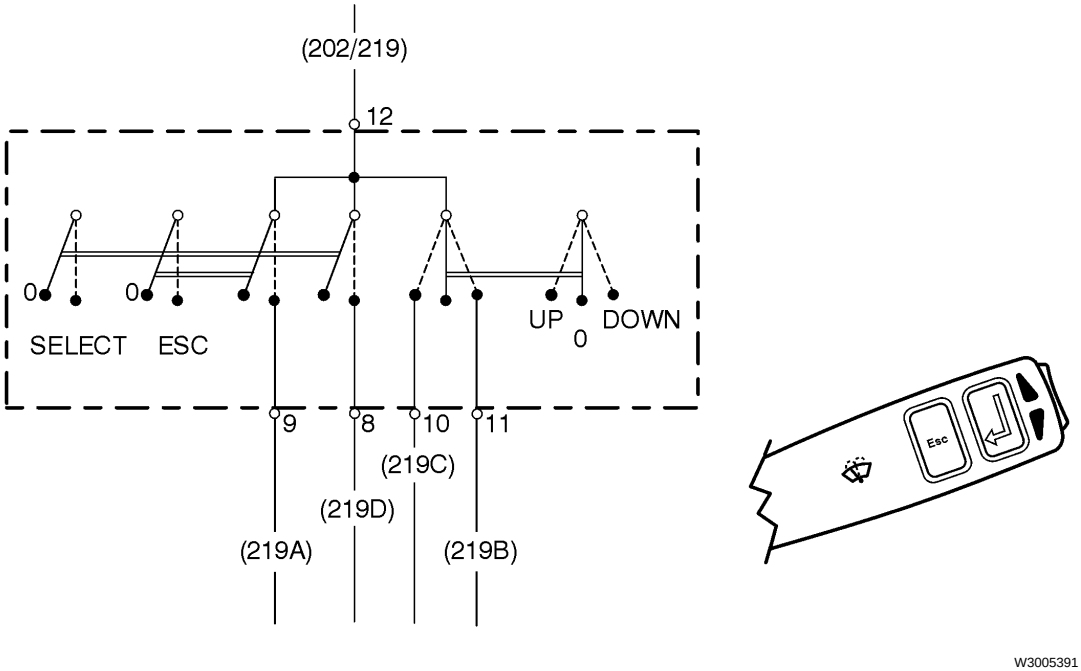


Fig. 59: Graphic Display Esc/Select Switch

Note: Numbers inside parenthesis are circuit numbers

Controls for the instrument cluster's graphic display window are located on the stalk switch to the right of the steering column. The Esc and Select buttons allow for different vehicle information to be displayed. The up and down buttons at the end of the stalk are used to scroll through the various display menus.

For more complete information on the wiper/washer system, including troubleshooting and service procedures, see "Windshield Wiper System" service information in Group 36.

Graphic Display Switch Connector		
Pin	Circuit No.	Description
8	219D	"SELECT" Input
9	219A	"ESCAPE" Input
10	219C	"UP" Input
11	219B	"DOWN" Input
12	219	Common 12V Supply

Cruise Control, Turn Signal and Headlamp Dimmer Switch

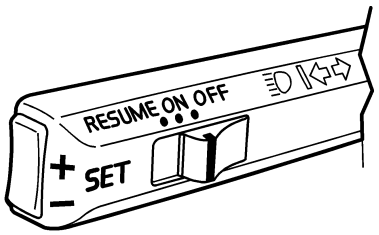
The controls for turn signals, cruise control and high beam/low beam selection are on the stalk switch on the left-hand side of the steering column. The high beam/low beam switch works by pulling back on the stalk. This switch includes a “flash to pass” feature.

It is possible to increase or decrease the engine speed by pressing the button at the end of the stalk. Pressing the top of the button, toward the + sign, will increase vehicle speed while pressing the lower part of the button, the – sign, will decrease speed. To return to the set speed, move the switch on the stalk toward “Resume”.

The Cruise control switch may also be used to control engine speed on vehicles equipped with PTOs.

For more complete information on the exterior lighting system, including troubleshooting and service procedures, see “Lighting Control Module (LCM) Fault Codes” in Group 35:

For vehicles equipped with steering wheel switches, to fine more complete information on the steering wheel switches, including troubleshooting and service procedures, see “Steering Wheel Module Fault Codes” in Group 36.



W3002499

Fig. 60: Cruise Control Switch

Left Hand Stalk Switch Connector (14-way)		
Pin	Circuit No.	Description
1	597-B	Common
2	562A	Cruise control On
3	565A	Cruise control Resume
4	564A	Cruise control Set –
5	563A	Cruise control Set +
6	—	Not used
7	—	Not used
8	—	Not used
9	—	Not used
10	33B	Flash-to-pass to LCM
11	33A	Hi/Low select to LCM
12	112	Left turn to LCM
13	113	Right turn to LCM
14	0XL-4	Common ground

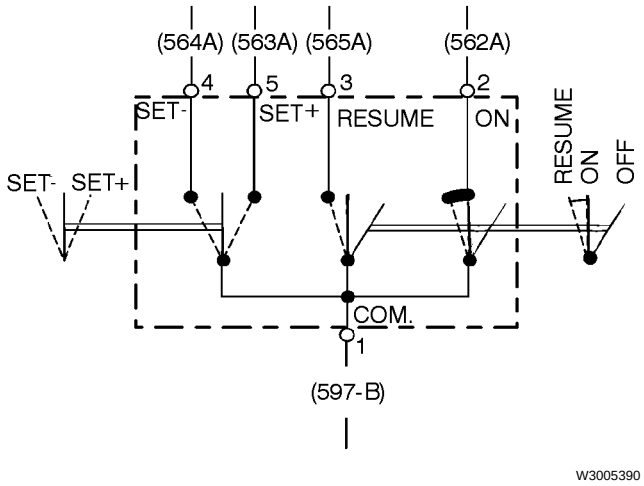


Fig. 61: Cruise Control Switch Logic Diagram

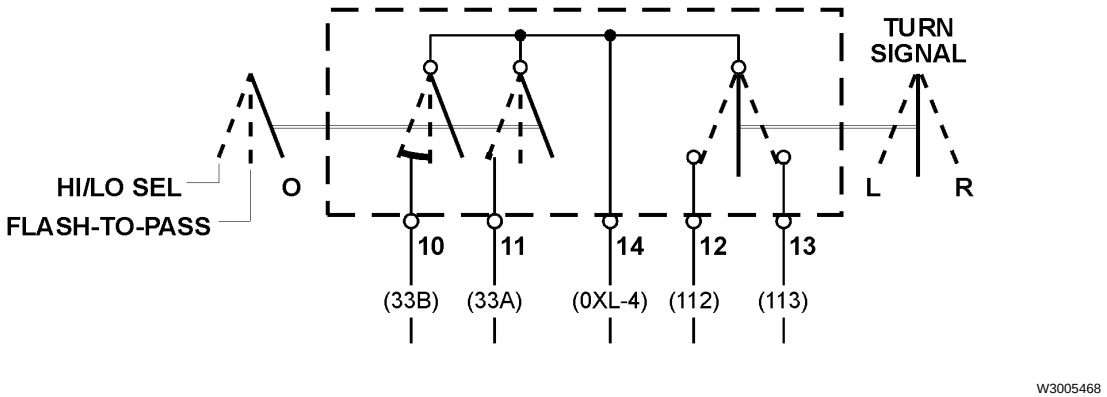
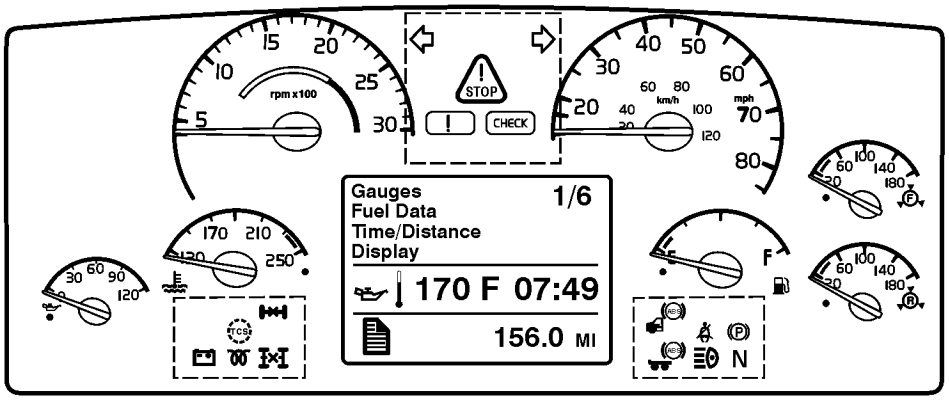


Fig. 62: Turn Signal and High/Low Beam Switch Logic Diagram

Note: The turn signal and hi/lo beam switches are logic switch inputs to the Light Control Module (LCM). They do not carry any current load.

Instrumentation



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In November 2002, an updated instrument panel was introduced for the VN and VHD, with a number of changes from panels included in earlier models. Particular variants depend on the options chosen for the vehicle.

For instrumentation design, troubleshooting and service procedures, see VN/VHD service information in group 38.

Note that all gauges and telltales may not be used in all vehicles.

Lighting System

The lighting system of the VN/VHD series may incorporate different design lamp assemblies for each vehicle type.

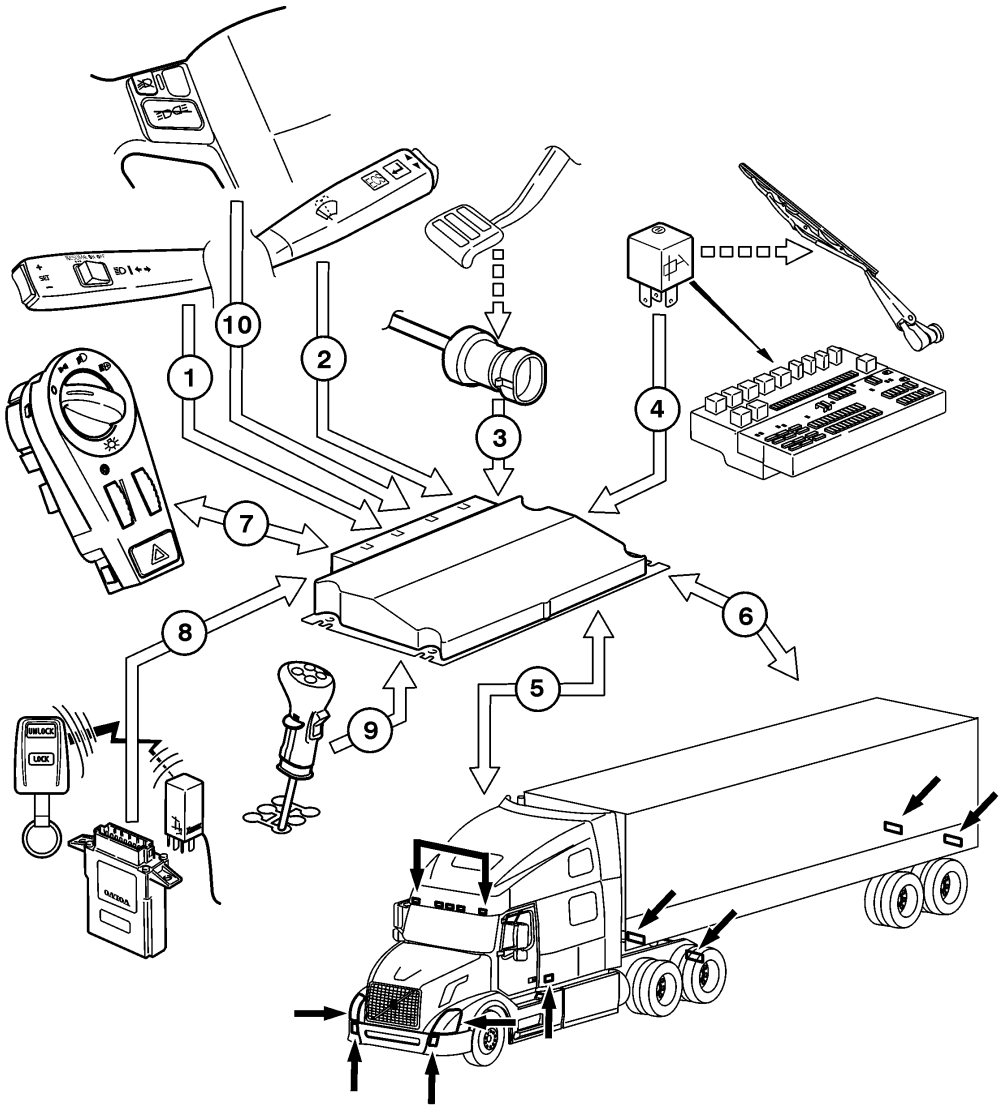
Daytime running lights turn the front parking lamps on whenever the ignition switch is on, the park brake is released, and the engine is running.

Fog and driving lights are available. When switched on, these lights will alternate between fog lights with the headlamp low beams on, and driving lights with the headlamp high beams on.

For more information on the lighting system, including design and function, troubleshooting and service procedures, see the service information on lighting in Group 35.

Light Control Module

The Light Control Module (LCM) controls all exterior lighting functions separately from the interior lighting in the cab and optional extras installed on the vehicle. In addition, it controls the intermittent windshield wiper function and the windshield wiper function when the windshield washer is used. The control unit communicates with other systems via the J1587/1708 information link and the J1939 control data link.



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1 The combination high beam/low beam, turn signal switch transmits signals to the control unit.
2 The windshield wiper switch transmits input signals to control intermittent wiping and windshield wiping during windshield washing.
3 The brake pressure contacts transmit a signal to the control unit.
4 The control unit grounds the intermittent relay to activate the windshield wipers during intermittent wiping and windshield wiping during windshield washing.

Note: The fixed windshield wiper speeds are not controlled by the control unit.

5 The control unit supplies power to the tractor exterior lighting.
6 The control unit supplies power to the trailer exterior lighting when a trailer is connected.
7 The light control panel transmits signals to control the external lighting functions. Also, controls the dash and instrument cluster backlighting. (See “Light Switch” page 40.)
8 The central locking system transmits input signals to the control unit.
9 The reverse switch transmits an input signal to the control unit.
10 The control unit receives a signal from the steering wheel module for the headlamp and marker lamp interrupts.

Light Switch

External lighting functions are controlled via the Light Control Panel (LCP). The switch has three controls and three indicator lights (hazard warning lights are indicated by a flashing signal in the switch and turn signal flashing in the cluster).

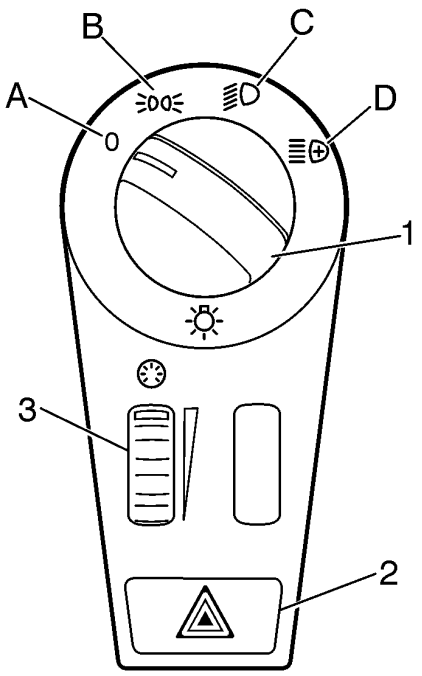
When the selected function is activated an input on the LCM is grounded.

Indicator lights are supplied with power by the LCM when the relevant function is active.

1 Light switch

- **A** “Off”-position
- **B** “Park”-position
- **C** “Drive”-position
- **D** “Drive+”-position (optional fog/driving lights)

2 Hazard warning lights switch/Hazard warning light indicator light
3 Rheostat for dash lighting



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The illustration shows the premium version of the switch. The other option does not have the "Drive+" position.

Supplemental Restraint System

Volvo vehicles may be equipped with a Supplemental Restraint System (SRS). The SRS is supplemental protection for use together with the safety belt. The SRS is designed to reduce the risk of injury to the driver's face and upper body.

The system consists of an inflatable bag mounted in the center of the steering wheel, and a control unit mounted on the bulkhead inside the cab. A chemical based gas generator attached to the rear of the bag inflates the bag in the event of a collision.

Sensors in the control unit detect deceleration. If the control unit detects a sufficiently violent deceleration (collision), the system is activated. The gas generator activates and fills the bag with a harmless gas within a few hundredths of a second. During a collision, after the bag has been filled, the gas flows out through two holes in the back of the bag. These holes are large enough to let the airbag collapse slowly, gently catching the driver.

The control unit also contains a standby power unit which can supply the system with power for a short time should the normal power supply be broken.

For more information on SRS see the service information in Group 88.

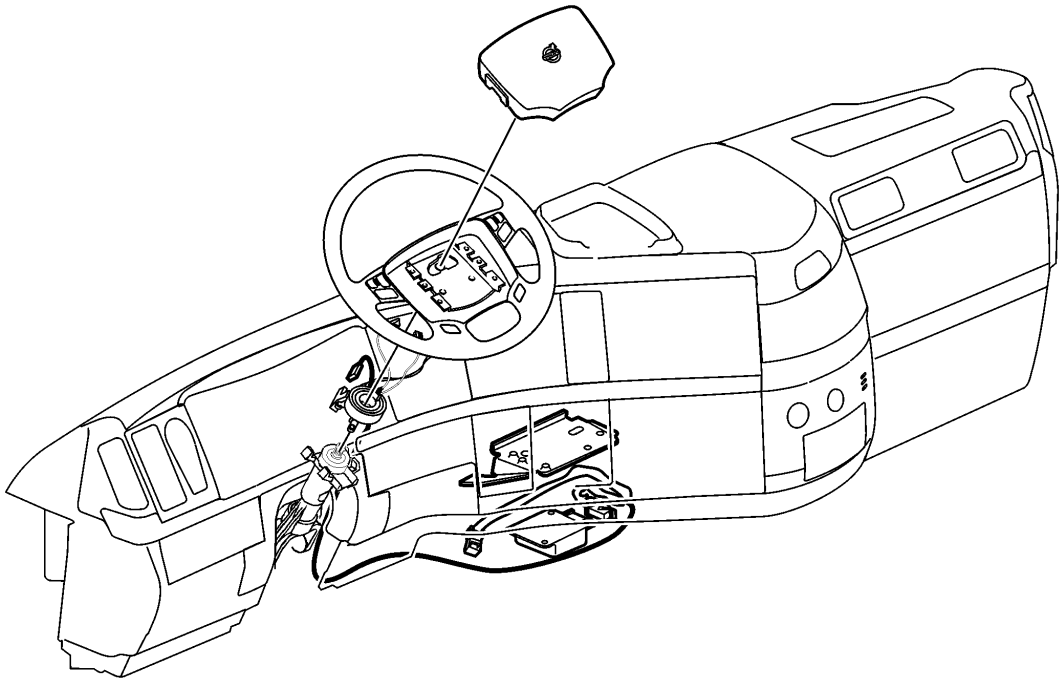

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Fig. 63: SRS System

Vehicle Electronic Control Unit

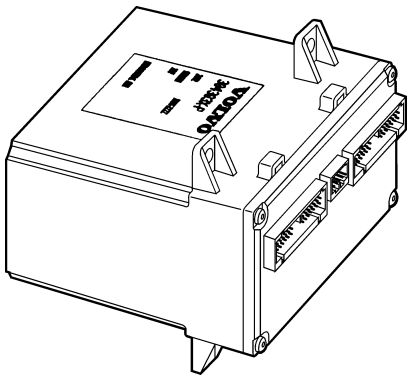


Fig. 64: VECU

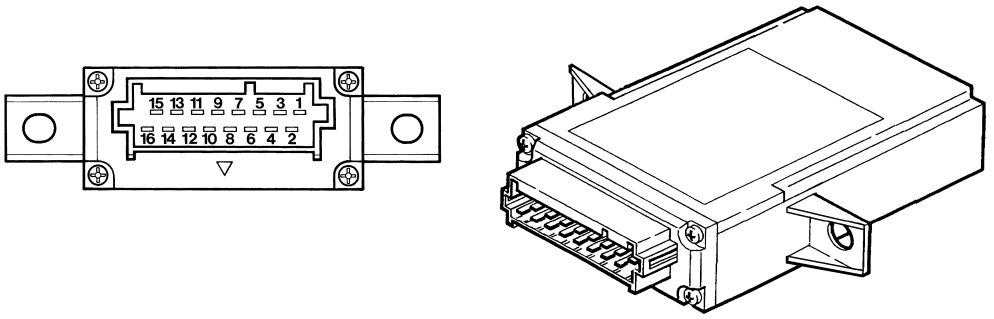
Vehicles are equipped with a Vehicle Electronic Control Unit (VECU), located under the fuse and relay panel. The VECU is accessible by removing the front TEC panel.

The VECU receives inputs and generates output signals for functions associated with cab devices. It also converts information into digital data to be broadcast over the J1587/1708 Information Data Link and the J1939 Control Data Link.

Each VECU is programmed with a specific vehicle dataset according to what the customer has ordered for that vehicle. This dataset is stored in the VECU memory, making the VECU unique to each vehicle. For this reason, it is not possible to “swap” a suspected faulty VECU with one from another vehicle without reprogramming the replacement VECU.

For more information on the design and troubleshooting of the VECU, see:”Vehicle Electronic Control Unit, MID 144” in Group 364.

Central Door Lock Module



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Central door locks are an optional feature. The central locking can be activated from either the passenger or driver side door lock. If the main supply is activated with one door locked and one unlocked, both sides will be automatically unlocked to prevent the driver from accidentally being locked out.

The Central door lock module is located in the TEC panel, below the fuse and relay panel. The door lock module is accessed by removing the fuse/relay panel.

Central Door Lock Module Connector				
Pin	**Circuit Number**	**Description**	**Input /Output**	**Characteristics**
1	710-A	Battery+ supply voltage	I	Unswitched battery (+) supply
2	713R	To passenger side motor - lock	O	Switched to Batt.
3	713L	To driver side motor - lock	O	Switched to Batt.
4	714R	To passenger side motor - unlock	O	Switched to Batt.
5	714L	To driver side motor - unlock	O	Switched to Batt.
6	717	Data, remote from remote relay	I	
7	719	Collision unlock from SRS	I	
8	712	To passenger side switch	I	Externally switched to GND or open
9	711	To driver side switch	I	Externally switched to GND or open
10		Not used		
11	715	Door switch - unlock	O	
12		Not used		
13	716	Door switch - lock	O	
14	714-LC	Signal indication to LCM	O	Flasher
15		Not used		
16	0C-C	Battery ground	I	Battery GND

Smoke Detector

VN sleeper cabs may be equipped with an optional smoke detector. If equipped, the smoke detector will be located on the sleeper headliner. The smoke detector includes an alarm and indicator light / test button. The chart below gives the indicator lamp and alarm operation for the conditions listed.

Operation Mode	Indicator Lamp	Alarm
Normal	Flashes every 45 seconds	Silent
Alarm Active	Flashes continuously	Pulsating
Low Battery Warning	Flashes every 45 seconds	Beeps every 45 seconds
Timer Mode	Flashes every 10 seconds	Silent

A 9–volt battery powers the smoke detector. The “low battery” indicator should sound approximately one month before the battery is depleted. To test the battery, press and hold the test button for approximately 5 seconds. If the battery is OK the alarm will sound as long as the test button is pressed. Always test the alarm for proper operation after the battery has been replaced.

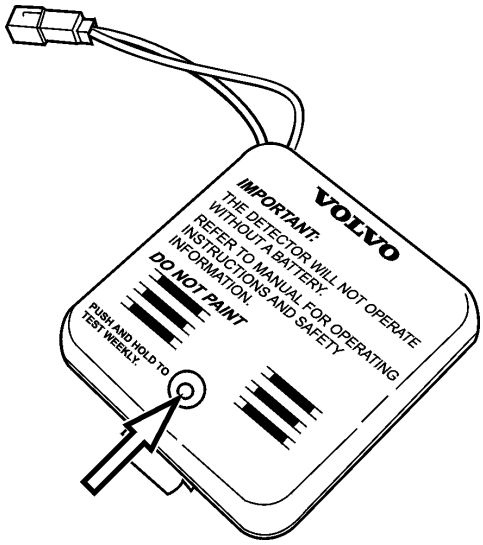

Fig. 65: Smoke Detector Indicator Lamp / Test Button

The smoke detector alarm may be erroneously activated by cigarette smoke, dust, exhaust fumes, etc. In these cases, the alarm may be temporarily silenced by pressing the test button or the disable switch on the left side of the dash. This initiates the timer mode, in which the alarm is silenced for 10 minutes, then goes back to normal operation. The timer mode can be initiated with the smoke detector in normal operation mode or after the alarm has been activated.

The simplified schematic below should only be used to clarify the design of the smoke detector. For detailed, vehicle specific schematics, see “VN/VHD VERSION2 Electrical Schematics, Group 37.”

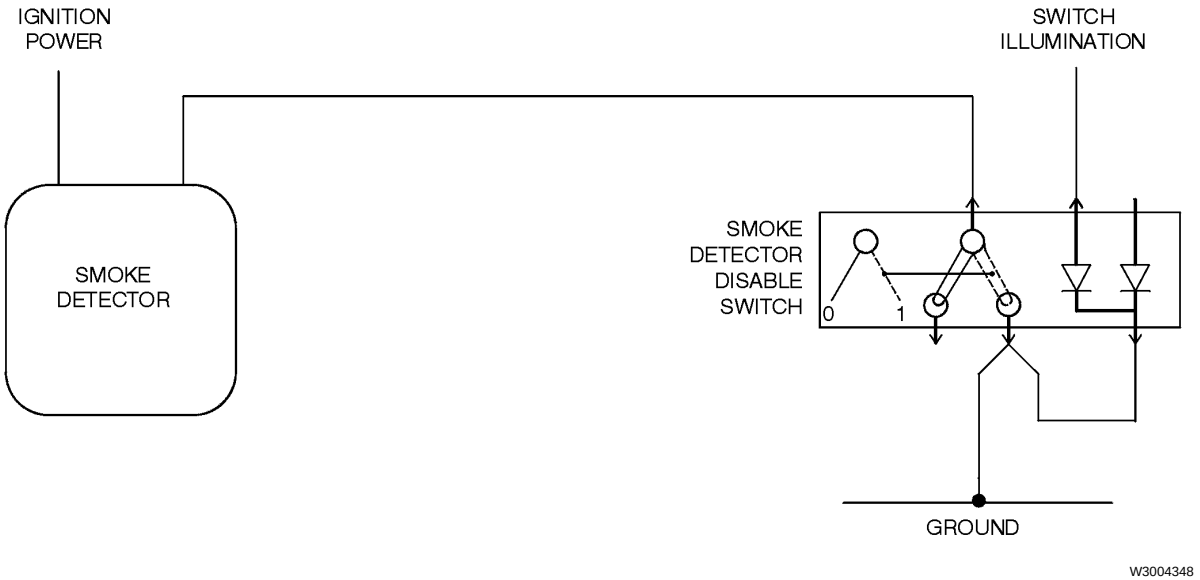

Fig. 66: Smoke Detector, Simplified Schematic

Horn

Both city and air horns are standard equipment. The air horns may be located on the roof, inside the right frame rail near the radiator, or on the left frame rail near the batteries. The city horn is located at the left front of the vehicle near the radiator. Both horns are operated by steering wheel controls. The city horn operates by pressing buttons on either the left or right steering wheel spoke. The air horn is electrically operated via a remote solenoid. The air horn button is the one in the center of the steering wheel on non-SRS equipped vehicles. On SRS equipped vehicles, the entire air bag module acts as the air horn button.

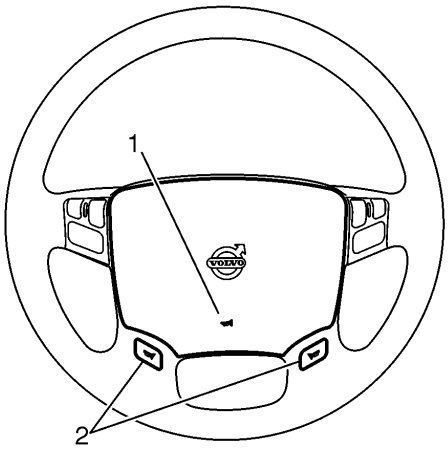

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Fig. 67: Steering Wheel

1 Air Horn
2 City Horn

The simplified schematic below should only be used to clarify the design of the horns. For detailed, vehicle specific schematics, see “VN/VHD VERSION2 Electrical Schematics, Group 37.”

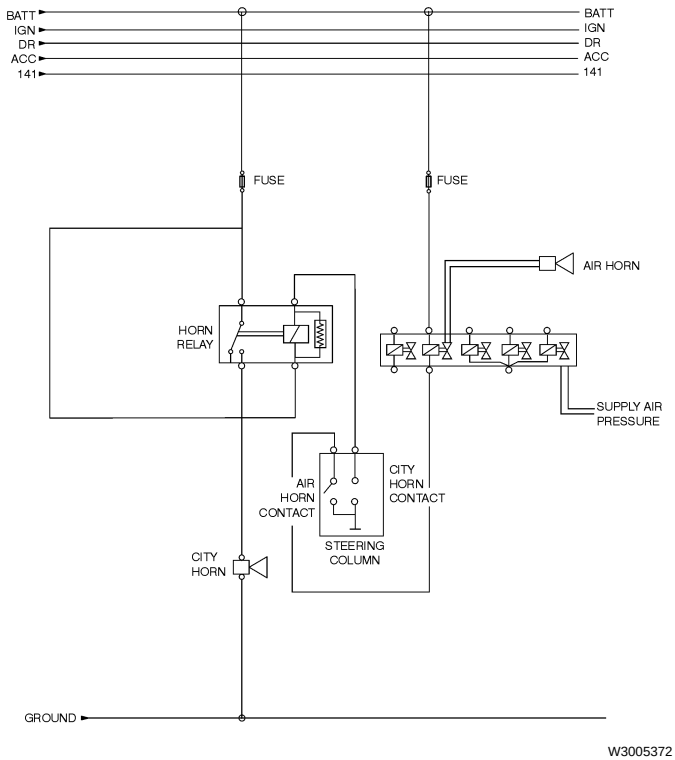

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Fig. 68: Horns, Simplified Schematic

TV Antenna and Speaker

A TV Prep Kit, including an antenna and coaxial cable, is standard for the VN780 cab and optional in the 630 and 670 cabs. The coaxial cable extends from the antenna in the headliner and runs behind the cabinets on the passenger side. It should be connected to a television, located in the cabinet on the passenger side.

The antenna is installed under the center headliner of the bunk area.

The antenna on is a “ribbon” type that is taped to the underside of the SMC roof panel in the bunk area.

The 780 also includes a remote TV speaker that is integrated into the sleeper control panel.

For more information on TV antenna troubleshooting and replacement, see TV antenna information in Group 39.

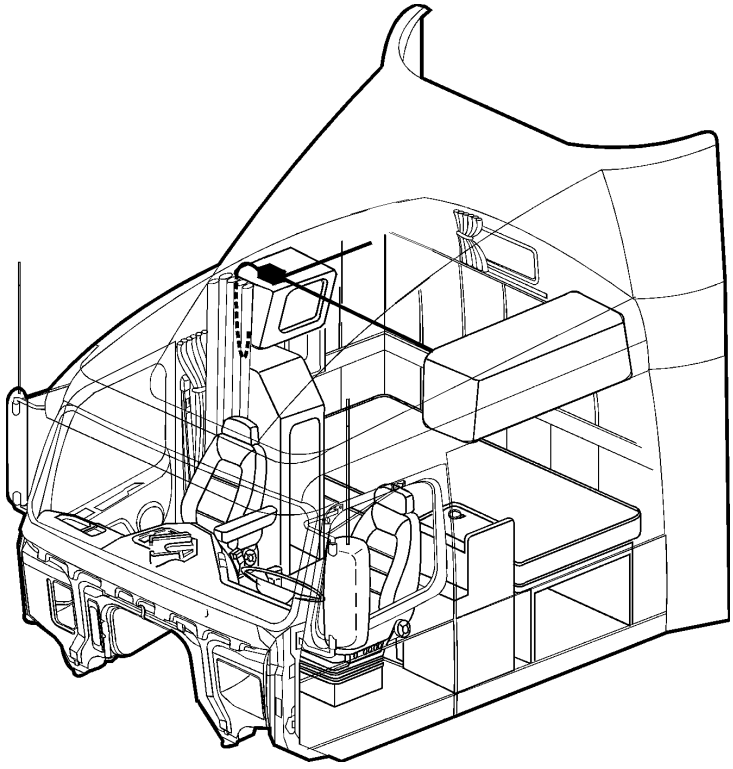

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Fig. 69: TV Antenna

Bodybuilder Wiring

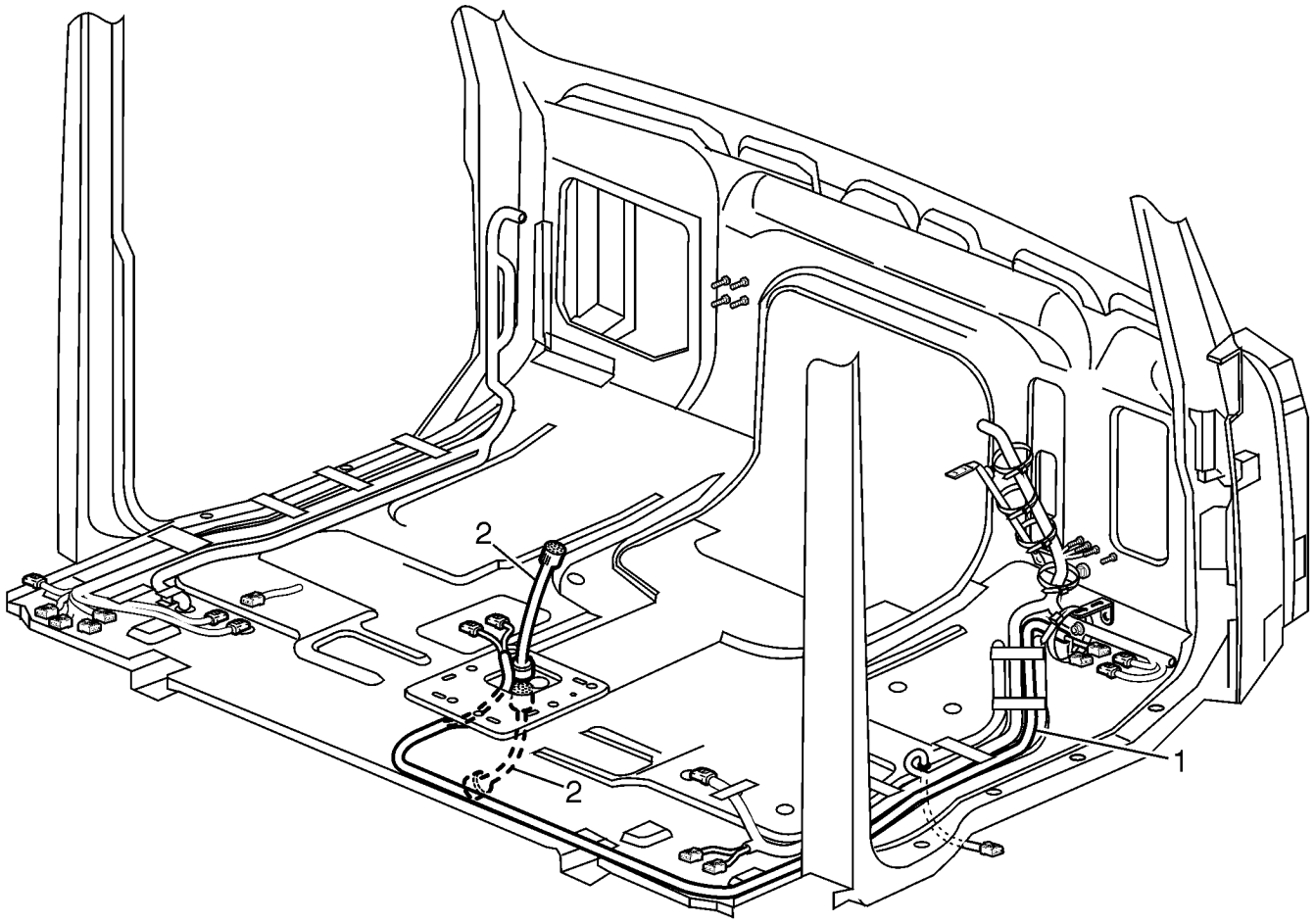

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Fig. 70: Bodybuilder Prep Kit Wiring

A Bodybuilder Prep Kit is standard in VHD truck models, and optional on tractors. It consists of the harnesses shown.

1 One jumper harness off the main cab harness. It runs from the A-pillar to the center of the cab. It routes along the right side of the cab floor to the back of the cab, then across to holes in the center of the cab where a console can be mounted. The circuits provided are listed in “Circuits in Bodybuilder Harness” page 48. Either 2 or 4 connectors will be used at each end of this harness: 4 with Allison transmissions and 2 with other transmissions. This harness allows the bodybuilder easy access to circuits in the main cab harness. For connector pin-outs, see the wiring diagrams in VN/VHD VERSION2 Electrical Schematics, Group 37.

2 Two identical harnesses for the center cab console, one inside the cab and one that goes to the outside. These have 31–pin Deutsch connectors on both ends, with 14 wires installed in each. These 14 wires can be used for any circuit the bodybuilder needs to install.

Circuits in Bodybuilder Harness

- Bodybuilder connector 1 is standard in all VHD's.
- Bodybuilder connector 2 is standard in all VHD's equipped with an Allison transmission.
- Bodybuilder connectors 3 and 4 are only supplied with a Volvo engine, when a complete bodybuilder prep is ordered (variant ELCL-CK).

Note: For Bodybuilder information, see the Bodybuilder Manual in group 90.

Bodybuilder Connector 1		
Pin	**Circuit #**	**Description**
A	0B	Ground
B	19	R terminal signal from alternator
C	BAT-A	25 amp fused battery circuit (maxifuse A2)
D	IGN-X	15 amp fused ignition circuit (fuse F66)
E	A177	to Allison Transmission
F	A178	to Allison Transmission
G	410-AD	Reverse circuit
H	IGN-Y	15 amp fused ignition circuit (fuse F60)
J	IGN-Z	15 amp fused ignition circuit (fuse F29)
K	563B	Stalk PTO engine speed increase
L	564B	Stalk PTO engine speed decrease
M	639-A	PTO1 output
N	573-A	PTO1 enable to Vehicle ECU
P		not used

Bodybuilder Connector 1		
Pin	**Circuit #**	**Description**
R		not used
S		not used

Bodybuilder Connector 2		
Pin	**Circuit #**	**Description**
A	NEU	Neutral signal
B	A312NC	PTO output enable relay from Allison
C	A312NO	
D	A312CM	
E	A314NO	Neutral indicator for PTO relay from Allison
F	A314NC	
G	A314CM	
H	A161-A	Allison transmission (ground return)
J	A117	Allison transmission
K	A118	Allison transmission
L	A143-L	Allison ECU power ground
M	A153	Allison transmission
N	A155	Allison transmission
P	A157	Allison transmission
R	A166	Allison transmission
S	A167	Allison transmission

Bodybuilder Connector 3		
Pin	**Circuit #**	**Description**
A	559T	Ground for BBM inputs
B	558B	Power for BBM inputs
C	558C	Power for BBM inputs
D	573F	PTO2 enable to BBM ECU
E	573G	PTO3 enable to BBM ECU
F	573H	PTO4 enable to BBM ECU
G	573J	PTO1 input to BBM ECU
H	573K	PTO2 input to BBM ECU
J	573L	PTO3 input to BBM ECU
K	573M	PTO4 input to BBM ECU
L	639X	PTO2 output to BBM ECU
M	639Y	PTO3 output to BBM ECU
N	639Z	PTO4 output to BBM ECU
P	564	Remote PTO engine speed decrease
R	563D	Remote PTO engine speed increase
S		not used

Bodybuilder Connector 4		
Pin	**Circuit #**	**Description**
A	582A	Engine shutdown #1 input
B	582B	Engine shutdown #2 input
C	641	Throttle interlock input
D	642	Engine speed limit input
E	643	Engine torque limit input
F	645	Road speed limit input
G	310A	PTO neutral interlock input
H	311E	PTO low split interlock input
J	328A	Split shaft PTO input
K	627A	Remote throttle enable input
L	557P	Remote throttle sensor (+)
M	640	Remote throttle sensor signal
N	559P	Remote throttle sensor (-)
P	913	Road speed output
R	911	System warning output
S	912	Databus triggered output

Bodybuilder Lighting Junction Box

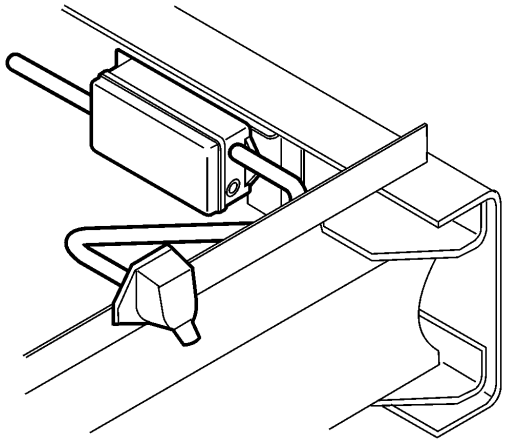


Fig. 71: Bodybuilder Junction Box and Trailer Receptacle, End of Frame Installation (typical)

A junction box at the back of the cab is optional in VHD models. It is usually mounted on the left framerail, behind the cab. It may optionally be located at the end of the frame, or a trailer receptacle may be installed.

The junction box contains the same 7 wires for rear circuits as the trailer receptacle. The Volvo circuit numbers for the standard wire colors are listed below.

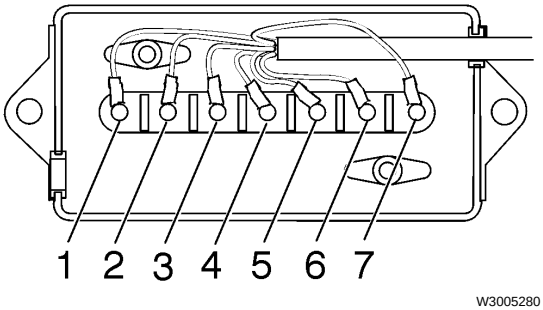


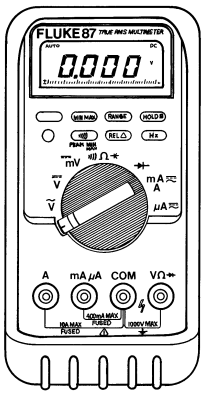
Fig. 72: Bodybuilder Junction Box, Inside View

Pin	Color	Circuit #	Description
1	Yellow	112	LH Turn Signal Light
2	Black	53	ICC Trailer Marker
3	Red	72	Stop Lights
4	White	OT	Ground
5	Blue	Aux	Auxiliary (12V ignition power)
6	Brown	51	Trailer Marker and Tail Lamps
7	Green	113	RH Turn Signal Light

Troubleshooting

Electrical System Troubleshooting

Troubleshooting Using a Digital Multimeter (DMM)



W2001014

Fig. 73: Fluke 87 Digital Multimeter

Available from Volvo (P/N 9510060)
or Kent-Moore (J-39200)

A Digital Multimeter (DMM) is one of the most important tools available for electrical troubleshooting. A multimeter such as a Fluke 87 is recommended for troubleshooting. It provides diagnostic capabilities such as current (amperage), resistance and voltage tests, as well as specialized features for automotive troubleshooting.

Always consult the DMM manufacturer instructions for the proper use of the meter before beginning testing.

Before using the DMM to measure resistance, check its calibration by touching the leads together. If there is a reading other than zero, subtract it from measurements made with the DMM.

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

CAUTION

Never use the ohmmeter mode of the DMM in a powered circuit, or as a substitute for a voltmeter or ammeter, since damage to the instrument will result. Use the ohmmeter mode only when power is removed from the circuit.

Troubleshooting Wiring and Connectors

General Troubleshooting Procedures

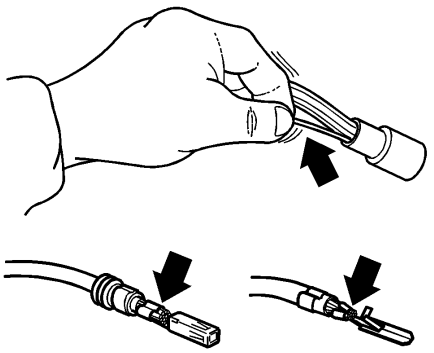
General Troubleshooting Procedures

- Use Multimeter J-39200 (or equivalent tool) to perform tests. The use of test lights is discouraged.
- When troubleshooting wiring and connectors use breakout boxes/harnesses when available. A list of various breakout boxes/harnesses is included in .
- Never pierce the wiring insulation with test probes.
- Do not pierce through seals on water-resistant connectors.
- Never insert test probes into connectors. The probes may spread the terminals and cause intermittent faults.
- If breakout boxes/harnesses are not available, contact the metal outer edges of connector terminals as necessary to take readings.
- Consult “VN/VHD VERSION2 Electrical Schematics” in Group 37 for vehicle specific wiring and connector information. These schematics include pin-out and vehicle location drawings for connectors.

Visual Inspection

Before beginning electrical checks, visually inspect the wiring and connectors.

- Inspect for corrosion in wiring or connectors. See “Corrosion” page 57.
- Check that terminal pins are not bent or damaged, locked into their connectors, and properly crimped.
- Check that the terminal pins make good mechanical contact with their mating pin. See “Contact Problems” page 58.
- To help locate intermittent faults, wiggle the wire and connector while testing.

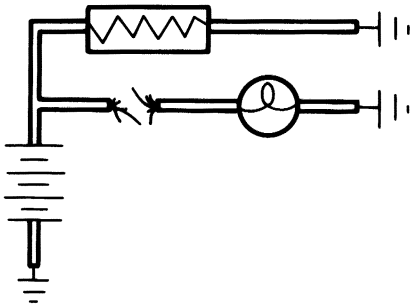


T3009648

Open Circuit

Whenever there is a complete break or interruption in the normal current path, such as a break in wiring from the source of power to the electrical unit or within the unit itself, current will not flow. In a circuit, current normally travels through the wires or cables, to switches and electrical unit(s), such as the starter solenoid and cranking motor, through another wire to ground and back to the source.

A break anywhere along this route results in an open circuit and the complete loss of power. An ammeter will not register at all because there cannot be current flow through an open circuit. A voltmeter, depending on where it is placed in relation to the open circuit, may or may not give a reading.



W3000489

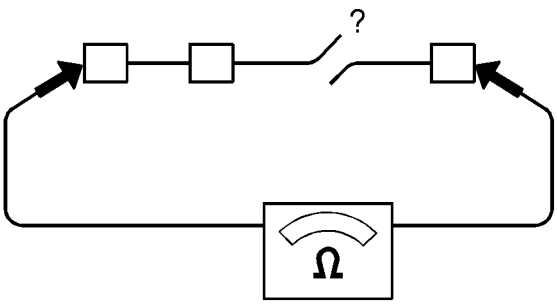
Checks

1 Visually inspect the circuit.

2 Disconnect the connectors at both ends of the wiring harness.

3 Measure resistance using multimeter J-39200 (or equivalent tool) between the ends of the wire. The expected value is <1 Ω. Readings of “OL” (infinite resistance) indicate an open circuit.
If an open circuit is detected, disconnect and test progressively smaller lengths of the circuit until the faulty wiring is located.

4 Test for intermittent faults by wiggling the connectors and/or wiring while monitoring the meter.



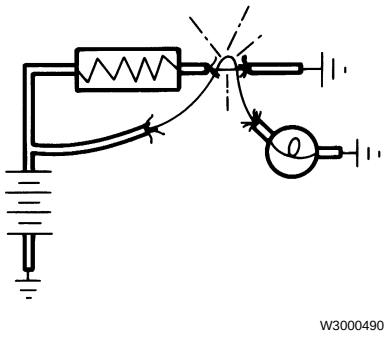
T3009650

Short Circuit

The term short circuit is used to describe another type of condition which can develop in electrical circuits or units. It refers to a circuit that is completed in the wrong way, such as two bare wires touching each other, so that the current bypasses part of the normal circuit.

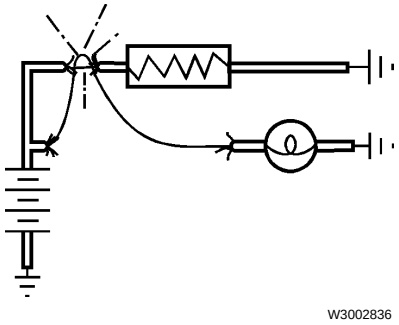
If the short circuit is to a ground wire this can result in blown fuses, open circuit breakers, wiring or component overheat, burned parts and insulation and of course non working components.
Hot, smelly insulation is always a sign of trouble. If the wire melts through, there is no electrical path, so the circuit then becomes open.

If the short circuit is to a power wire it can result in components operating at inappropriate times. This occurs because power that normally should be supplied by one component switch or circuit is bypassed by the short circuit and power is supplied by a different switch or circuit.



W3000490

Short circuit to ground



W3002836

Short circuit to power wire

Checks – Short circuit to ground

1 Visually inspect the circuit.

2 Turn ignition key to ON or ACCESSORY as necessary.

3 Activate the suspect circuit and check if the fuse blows or if there is excessive current draw.

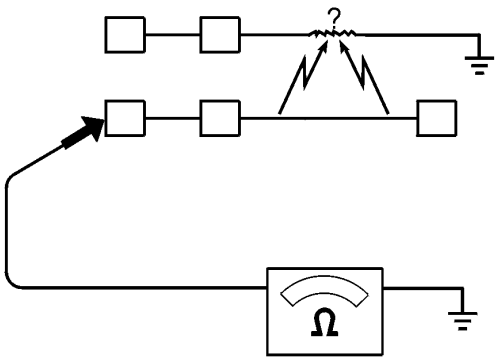
4 Turn the ignition OFF. Disconnect the connectors at both ends of the wiring harness.

5 Measure resistance using multimeter J-39200 (or equivalent tool) between the end of the wire and ground. The expected value is “OL” (infinite resistance). Low resistance readings may indicate a circuit shorted to ground. If a short circuit is detected, disconnect and test progressively smaller lengths of the circuit until the faulty wiring is located.

6 Test for intermittent faults by wiggling the connectors and/or wiring while monitoring the meter.

CAUTION

Do not check a short circuit by using a jump wire across the fuse, terminals or by installing an oversized fuse in the fuse panel. This could cause damage to the electrical system.



W3003970

Checks – Short circuit to power

1 Visually inspect the circuit.

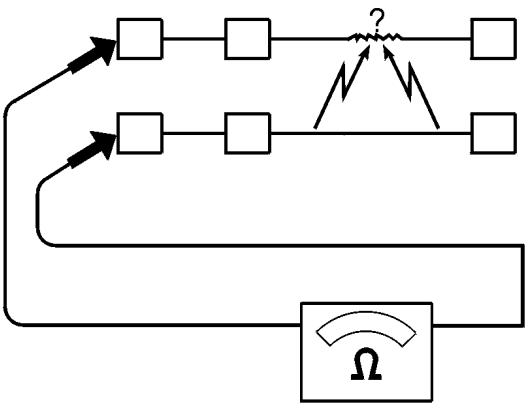
2 Turn ignition key to ON or ACCESSORY as necessary.

3 Activate the suspect circuit and check to see if another inappropriate circuit operates at the same time.

4 Turn the ignition OFF. Disconnect the connectors at both ends of the wiring harness of each affected circuit.

5 Measure resistance using multimeter J-39200 (or equivalent tool) between the ends of the wires of each affected circuit. The expected value is “OL” (infinite resistance). Low resistance readings may indicate the circuit shorted together. If a short circuit is detected, disconnect and test progressively smaller lengths of the circuit until the faulty wiring is located.

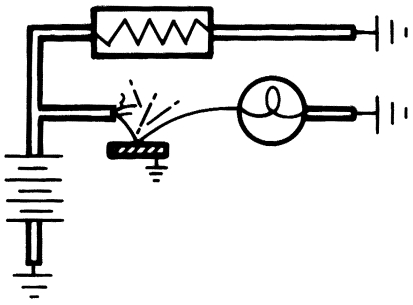
6 Test for intermittent faults by wiggling the connectors and/or wiring while monitoring the meter.



W3003969

Grounded Circuit

A grounded circuit is similar to a short circuit in that the current bypasses part of the normal circuit. In this instance, the current flows directly to ground. This may be caused by a wire touching ground or part of the circuit within a unit coming in contact with the frame or housing of the unit.
A grounded circuit may also be caused by deposits of oil, dirt and moisture around connections or terminals.



W3000491

Checks

1 Visually inspect the circuit.

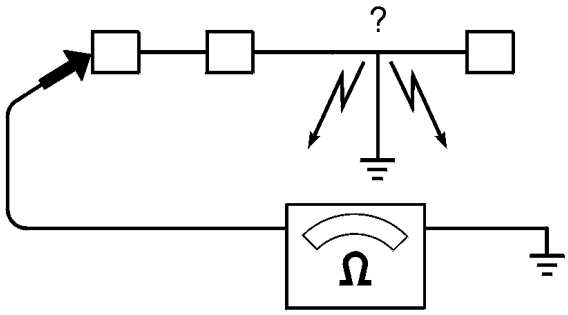
2 Turn ignition key to ON or ACCESSORY as necessary.

3 Activate the suspect circuit and check if the fuse blows or for excessive current draw.

4 Turn the ignition OFF. Disconnect the connectors at both ends of the wiring harness.

5 Measure resistance using multimeter J-39200 (or equivalent tool) between the end of the wire and ground. The expected value is “OL” (infinite resistance). Low resistance readings may indicate a grounded circuit. If a grounded circuit is detected, disconnect and test progressively smaller lengths of the circuit until the faulty wiring is located.

6 Test for intermittent faults by wiggling the connectors and/or wiring while monitoring the meter.



W3003968

CAUTION

Do not check a short circuit by using a jump wire across the fuse, terminals or by installing an oversized fuse in the fuse panel. This could cause damage to the electrical system.

High Resistance

A high resistance condition in a circuit is often difficult to find. Symptoms of high resistance include dim or flickering lamps or inoperative components (since current decreases when resistance increases, the components may not be receiving enough current to operate properly).

The first step in finding a high resistance problem should be a visual check of all connectors and wires in the circuit.

Possible cause of High Resistance:

- A chafed cable where one or more wires have been cut, effectively reducing the diameter of the wire.
- An inadequate power or ground path due to corrosion, loose terminals or fasteners.
- A terminal that is worn due to excessive cycling (connecting, disconnecting).
- An internal component fault.

Corrosion

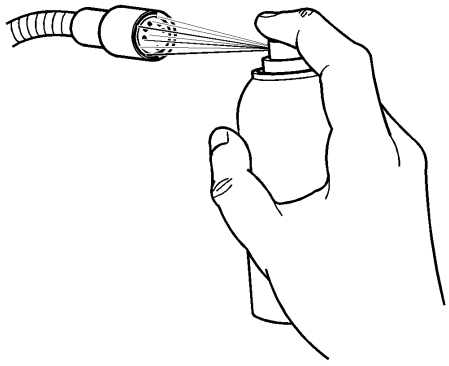
Corrosion in sockets and connectors is caused by acids and road salt reacting with the copper. Connections exposed to concentrated splash, spray and wheel wash should be sealed tightly. Periodically check to see that all wiring connections are clean and tight.

Corrosion in wiring is due mainly to poor wire splicing or breaks in the wire insulation. Wires should not be spliced by twisting them together and wrapping with tape.
The proper way to splice two wires together is outlined in “Wire Splice, Crimp and Seal” page 70 and “Wire Splice, Solder and Seal” page 68.
Several hand crimped connectors are available on the market which will result in a good joint or union, but most do not provide a water tight seal.

Corrosion is also caused by terminals that are improperly fastened to the vehicle. Excessive vibrations at the contact points will cause fretting corrosion.

Corroded wires should be replaced as needed. Corroded terminals should be cleaned with wire brushes or scraped as needed to remove corrosion. It’s important to also check for corrosion in the wire if a terminal is corroded. The wire can act like a wick and absorb moisture. Additionally, terminals may be cleaned with cleaning chemicals designed for electronic terminal cleaning, and then blown dry with compressed air. But there is a risk of forcing the moisture further into the terminal or cable.

After cleaning, closely inspect the terminals to determine their serviceability. Check for proper contact as outlined in “Contact Problems” page 58. Replace any connectors that are determined to be in less than serviceable condition.

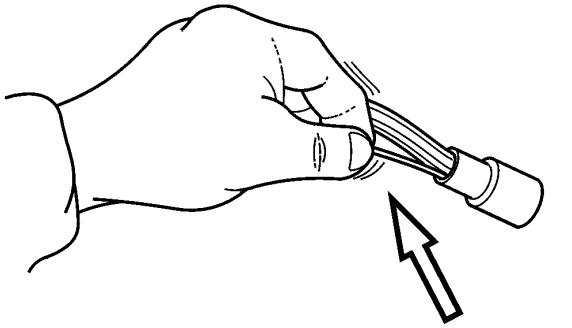


T3009652

Contact Problems

Note: The Volvo engine ECU connector pins are not serviceable, the terminals are factory sealed. If a loose, corroded or damaged pin is found, the engine harness must be replaced.

Loose or corroded connections are often the cause of intermittent faults. Intermittent faults are usually difficult to find since the fault must be active at the time of troubleshooting to insure that the fault is corrected. Wiggling the suspected wiring or connector while monitoring the circuit function or multimeter may be effective in helping to locate intermittent faults.

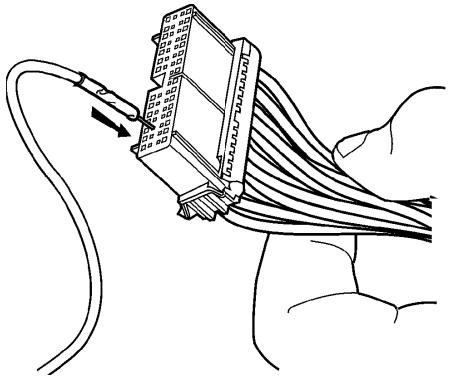


W3003965

For the JAE connector pins used on Vehicle ECUs and the instrument cluster use tool J-42449-1 (found in kit J-42449) to check for proper contact.

- Insert the gauge into the terminal.
- Move the gauge in and out of the terminal to check that the terminal has proper clamping force on the gauge.

If the terminal does not have any clamping force, is weak, or loose the terminal must be replaced. To replace the terminal, see “JAE Terminal, Replacement” page 72.



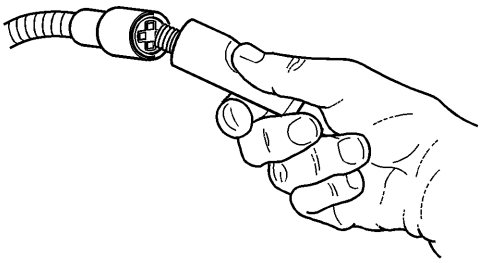
W3003967

For other types of terminal pins or connectors, use a new mating terminal of the correct type to check for proper contact. Several types of terminals can be found in available kits. If the terminal does not have any clamping force, is weak, or loose the terminal must be replaced.

Note: Excessive use of the test gauge will degrade the clamping force of the mating terminal and may cause additional intermittent faults.

Dielectric Grease

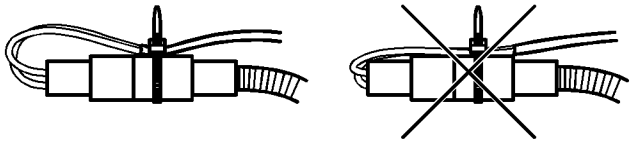
The use of dielectric grease is recommended for certain **non-sealed** plugs, sockets, and connectors that are exposed to the weather. It reduces corrosion by providing protection against moisture and the elements. Sealed connectors do not require dielectric grease.



T3009653

Routing and Clipping

Wiring should be secured as necessary to prevent rubbing against objects that may wear through the wiring insulation and cause circuit failures.
When securing wiring near connectors, switches, or sensors with cable ties, leave some slack at the connector to prevent vibration from pulling the wiring out of the connector.



T3009651

CAUTION

If a circuit must be added to the electrical system, and will carry high currents or frequencies, route it in a location AWAY from the J1587 data link wires 400/401, and the J1939 wires 406/407, to prevent mutual inductance from interfering with data link functions.

CAUTION

Follow Volvo's instructions on "Data Link Troubleshooting and Repair" in group 371 if repairs are needed to Data Link wires. These wires are used for the transmission of data for diagnostic messages and gauges. Improper repair can cause these functions to fail.

Switch Troubleshooting

Checking the continuity between pin or cavity positions in various operating positions may help troubleshoot switches. The switch detail information in “Switch Logic Diagrams” page 26 or in the electrical schematics may be used as a guide when checking for proper switch operation.

Troubleshooting information on specific switches may also be found in various service information that deals with specific components or systems.

Electronic Control Unit (ECU) Troubleshooting

Generally there is no actual testing of electronic control units or electronic modules. Electronic control unit/module connector wire input or output may be tested, but caution must be used not to introduce problems where none exist. Simple troubleshooting of such things as power and ground supply or sensor continuity may be attempted with the ECU disconnected.

If tests exist for an ECU, the details of those tests will be covered in the service procedures for that ECU, or in the VCADS Pro tool.

Service Procedures

General Work Practices

The following section provides electrical reference information, as well as suggested methods for service and maintenance. The recommended schedule for maintenance is outlined in the Operator's Manual for each vehicle.

Continual electrical problems may be the result of incomplete or inadequate diagnosis and improper repairs. Unless the root cause of a problem is determined, it will fail again, i.e., a blown fuse will blow again unless the cause of the overload is located. Make every effort to determine the root cause of a failure.

Checking the following items will help to eliminate some of the most common problems found in heavy duty trucks.

- Shorts in cables and harnesses: Check for proper routing and the security of cables and harnesses. Cables that rub and chafe objects or flap around will ultimately lead to short circuit or open circuit conditions (see "Troubleshooting Wiring and Connectors" page 51).
- Corrosion in sockets and connectors is caused by acids and road salt reacting with the copper. Connections exposed to concentrated splash, spray and wheel wash should be sealed tightly. Periodically check to see that all wiring connections are clean and tight.
- Corrosion is due mainly to poor wire splicing. Wires should not be spliced by twisting them together and wrapping with tape. The proper way to splice two wires together is outlined in "Wire Splice, Solder and Seal" page 68 and "Wire Splice, Crimp and Seal" page 70. Several hand crimped connectors are available on the market which will result in a good joint or union, but most do not provide a water tight seal.
- The use of dielectric grease is recommended for terminals exposed to the weather: salt, dirt, or water. Dielectric grease is needed to provide protection against moisture and the elements. To apply dielectric grease, remove the connector from the connection. If corroded, clean with a wire brush. After cleaning, spray a light film of dielectric grease on the terminal to seal out salt, dirt, and moisture.
- When replacing wires, it is important that the correct size wire be used. Each harness or wire must be held securely in place to prevent chafing or damage to the insulation due to vibration. Never replace a wire with one of a smaller size; never replace a fusible link with a wire that is larger, or of a different length. See "Replacement Wire Sizes" page 67 for more information.
- A high resistance condition in a circuit is often difficult to find. Symptoms of high resistance include dim or flickering lamps or inoperative components (since current decreases when resistance increases, the components may not be receiving enough current

to operate properly). The first step in finding a high resistance problem should be a visual check of all connectors and wires in the circuit. Corrosion or loose, dirty connections could cause a high resistance problem.

- Many problems are the result of poor grounds. Poor grounds can cause open circuits or intermittent failures.
- Do not use test probes. Pricked holes from test probes/test lights cause future problems (corrosion) by piercing wire insulation.
- Use caution when steam cleaning or pressure washing electrical components or wiring. This can damage the components.

Connectors

Packard, AMP, JAE, KOSTAL and Deutsch connectors are used throughout the electrical system. Refer to the connector manufacturer's literature for contact removal, crimping and insertion instructions. Special tools are required for these procedures. If contact removal is attempted with an ordinary pick, there is a good chance that the terminal will be bent or deformed. These terminals must not be reused once they are bent.

Molded-on connectors require complete replacement of the connection. This means splicing a new connector assembly into the harness. It is important that the best possible bond at all wire splices be made.

Environmental connections are used to isolate terminations from the environment. Environmental connections must not be replaced with standard connections – only with environmental connections. If a connector is replaced with one having more cavities, the unused cavities must be plugged to provide an environmental seal.

Use care when probing the connections or replacing terminals in them; it is possible to short between opposite terminals. If this happens to the wrong terminal part, it is possible that damage may be done to certain components. Always use jumper wires between connectors for circuit checking. Never probe through seals or wire insulation.

When diagnosing for possible open circuits, it is often difficult to locate them by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector or a sensor in the wiring harness may correct the open circuit condition. This should always be considered when an open circuit is indicated while troubleshooting. Intermittent problems may also be caused by oxidized or loose connections.

Battery Charging and Jump Starting

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

CAUTION

It is very important to exercise caution when charging batteries or jump starting a vehicle with a modern electrical system. Electronic control units can be damaged by voltage spikes and current surges created by jump starting. To minimize any risk for damage to the electronic components, see the following guidelines for working with the electrical system.

If the batteries are discharged to the point where they do not have enough stored energy to start the engine, they should be recharged using a low charge current, **not to exceed 16 volts.**

For full access to the batteries, they must be disconnected and removed from the battery box. When disconnecting terminals, always disconnect the main ground terminal first (after disconnecting additional grounds). When reconnecting, always connect the main ground terminal last.

DANGER

Personal injury risk. In vehicles with SRS Airbags, make sure that no one is inside the cab when connecting the battery. Otherwise, serious personal injury could occur due to possible deployment of the airbag.

Jump Starting the Engine

WARNING

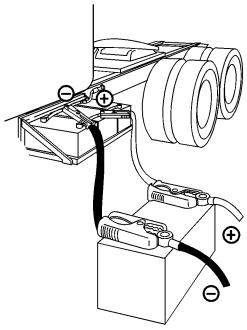
Do not attempt to jump-start a vehicle equipped with Delco Maintenance Free batteries if the test indicator is light yellow. Replace the battery instead.

WARNING

Always wear eye protection when working around batteries to prevent the risk of injury due to contact with sulfuric acid or an explosion.

WARNING

Do not use a “Hot Shot” type starting cart, as most use extremely high voltages. Use of a “Hot Shot” device to jump start the vehicle will seriously damage the ECUs and other electrical equipment.



W3002432

If the vehicle needs to be restarted immediately, use starting batteries. DO NOT use battery chargers with “boosting” capability. These utilize a high voltage that will cause damage to the vehicle electrical and electronic components.

When jumping batteries to start an engine, it is important that the jumper cables are connected directly from one set of batteries in one vehicle to the other set of batteries in the other vehicle. This is so the cranking current is carried through the proper starter wiring.

To access the batteries on a vehicle equipped with side fairings, open the fairing access cover. “Jumper studs,” which are longer and made of different metal than the other battery post nuts, are factory installed on one battery positive and negative post. These jumper studs are designed to accept the jumper cable claws.

Connect the jumper cables to the positive, or “hot” terminal first and the ground terminal last. When disconnecting the cables, disconnect the ground terminal first. Connect the jumper cable clamps to the discharged battery first and to the booster battery last. Avoid creating sparks by making all connections quickly and firmly. Do not permit the vehicles to touch each other when jump starting.

Welding

CAUTION

Welding on trucks can damage the vehicle electrical system/components due to the voltage and current spikes that normally occur when welding. It is preferable to avoid welding on an assembled truck, but if any structure on or in contact with the vehicle must be welded, follow the recommendations below:

DANGER

Personal injury risk. In vehicles with SRS Airbags, make sure that no one is inside the cab when connecting the battery. Otherwise, serious personal injury could occur due to possible deployment of the airbag.

CAUTION

Do not weld on the engine or engine components. Welding on the engine or components mounted on the engine can cause serious damage to the engine ECU.

- Before welding on the vehicle, disconnect power to the component being welded.
- Disconnect both the positive (+) and negative (-) battery cables. Disconnect the negative cable first. Reconnect the positive cable first. Vehicles equipped with battery “quick disconnect” must still have the cables removed directly at the battery.
- Disconnect engine/starter ground from the chassis. This connection is located outside the left hand frame rail in the engine compartment. Disconnect the power harness and vehicle interface harness at the engine Electronic Control Unit (ECU).
- If vehicles are equipped with systems that have their own Electronic Control Units (ECUs), such as ABS Brakes, Vehicle ECU, or instrument cluster, disconnect each control unit at each electrical connection. This “opens” the circuit and will prevent transient voltage from reaching one ECU to another.
- Attach the welder ground cable as close to the weld as possible (no more than 2 feet from the part being welded).
- Do not connect the welder ground cable to the engine ECU or the ECU cooling plate.
- Welding cables should not be allowed to lay on/near or cross over any electrical wiring or electronic component during the welding procedure.
- After the welding process has been completed and the welded parts have cooled, inspect wiring and components for possible shorts or damage which would allow the possibility of drawing excessive currents or cause short circuits when the batteries are reconnected.

Add-on Electrical Equipment

The electrical system in the vehicle is designed to perform under normal operating conditions without interference from other components.

Failure to properly install additional electrical components may adversely affect the operation of the vehicle, including the engine, electrical charging system, truck body, stereo system and the driver information systems.

Overloaded circuits are usually the result of an "add-on" option being improperly installed. The most common mistakes are:

- Improper installation of the wiring
- Poor terminal installation on the wire
- Improperly protected by a fuse or circuit breaker
- Overloaded circuits

One way to ensure proper installation is to carefully determine the proper wire sizing and fuse requirements for each circuit to be added. For wire sizes, refer to “Replacement Wire Sizes” page 67. Relays may be required for circuits with a higher current flow. In addition, wire connections must not disturb or interfere with any existing system(s) or component(s) within the vehicle.

CAUTION

Follow Volvo’s instructions on "Data Link Troubleshooting and Repair" in group 371 if repairs are needed to Data Link wires. These wires are used for the transmission of data for diagnostic messages and gauges. Improper repair can cause these functions to fail.

Volvo assumes no responsibility for any adverse effect upon the vehicle or any of its components or systems which may result from the improper installation of additional electrical equipment which was not supplied or recommended by Volvo.

Replacement Wire Sizes

The size of wire used when installing accessories or repairing existing electrical items is dependent on the length of the wire and power requirements of the accessory. The chart below can be used to determine the proper wire size for 12 volt systems.

To use the chart, mark the appropriate length for the wire being installed in the m/ft column. Also mark the rating in the amps/watts column. Then draw a line connecting the mark in the length column to the one in the rating column. The point where the line crosses the wire size column is the size of the wire required. If the line crosses the wire size column between gauge sizes, round up to the next larger size.

If replacing a wire and the amperage of the circuit is not known, it can be measured using an ammeter.

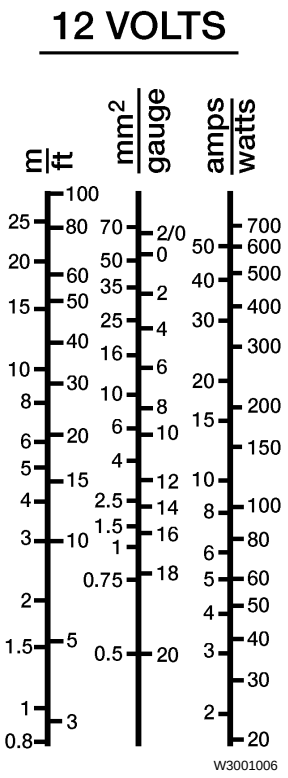


Fig. 74: Chart for calculating relationship between wire length, gauge and amperage/wattage

EXAMPLE:
A 12 volt hydraulic pump motor is rated at 20 amps.

The complete length of the circuit (power and ground sides) is approximately 20 feet.

A line drawn from 20 on the length column to 20 on the rating column crosses the wire size column at the 8.

This indicates that the minimum wire size for the application is 8 gauge.

Wire Splice, Solder and Seal

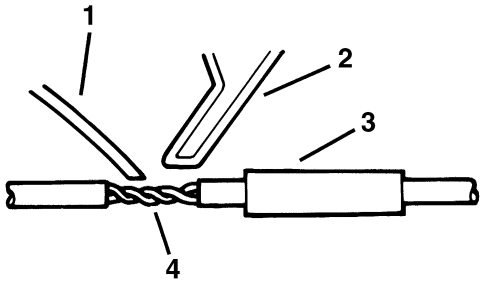
You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

Note: Wiring terminal and connector repair requires the use of proper terminals (Packard, JAE, ect.) and specialized tools. The following procedures are for general wiring repairs only.

Do not use acid core solder. When replacing wires use the correct wire size (see “Replacement Wire Sizes” page 67). Secure each harness or wire in place to prevent chafing or damage to the insulation due to vibration. Never replace a wire with one of a smaller size or replace a fusible link with a wire of a larger size.

When soldering wiring always use rosin flux solder to bond the splice. Use sealant shrink tubing to cover all splices or bare wires.

It is very important when soldering electrical terminals to obtain a good soldered joint. Use a quality soldering iron such as a Weller Model 440D or equivalent. A good quality soldering iron will offer dual heat in a medium range (145/210 watts). Use Kester alloy SN60, Flux-44 Rosin, 0.80 mm (0.032 in.) maximum diameter or equivalent.



W3000568

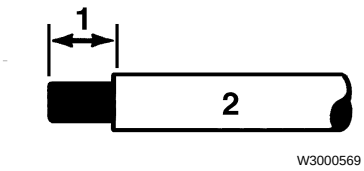
Fig. 75: Wire splicing

1 Solder
2 Soldering iron
3 Heat shrink tubing with sealant
4 Wires twisted

Soldering Procedure

1
Clean and tin the soldering iron tip.

2
Clean the terminal to be soldered.



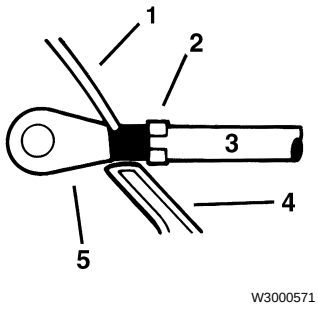
1 Strip as necessary
2 Wire

3
Strip the wire as necessary to fit the terminal. Do not cut or nick the wire when stripping.

4
Slide a piece of sealant shrink tubing onto the wire.

5
Insert the wire in the terminal and, with a pair of crimpers (as recommended by the connector manufacturer), squeeze the small tabs onto the wire insulation. Not all types of terminals have these tabs. Be certain to use the crimpers recommended by the connector manufacturer. With a blunt instrument, form the bare wire so that it will lay against the soldering area of the terminal.

6
Using the soldering iron, apply heat to the outside of the terminal while holding the solder on the wire on the inside of the terminal. When a sufficient amount of heat has been transferred from the gun through the terminal and into the wire, the solder will be melted by the wire. Melt a sufficient amount of solder on the wire and withdraw the solder and the tip of the iron.



1 Solder
2 Tabs (crimp over wire insulation)
3 Wire
4 Soldering iron
5 Terminal

NOTE: Do not hold the terminal with pliers or anything metal during the solder operation, as heat will be conducted away from the terminal.

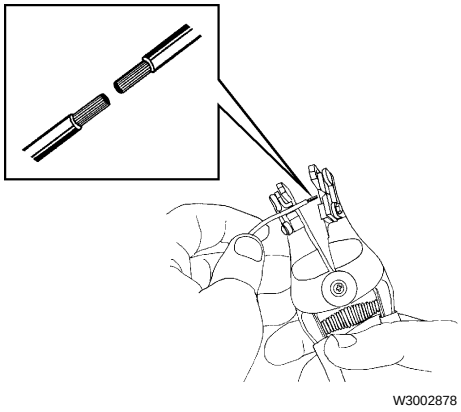
7
Slide the sealant shrink tubing over the soldered connection, making sure all exposed wire is covered. Heat the tubing with a heat gun to shrink. Shrink until the tubing is tight around the wire and the sealant is visible out of both ends of the tubing.

Wire Splice, Crimp and Seal

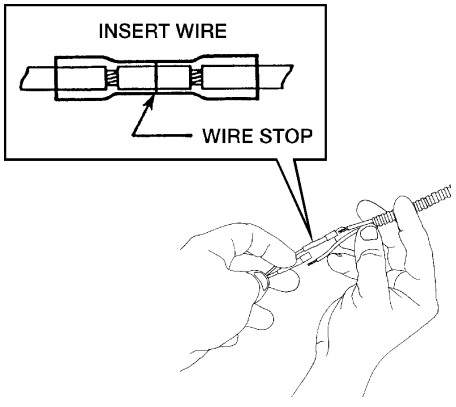
You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

Note: Wiring terminal and connector repair requires the use of proper terminals (Packard, JAE, etc.) and specialized tools. The following procedures are for general wiring repairs only. Always use properly sized wire when making wire repairs. See “Replacement Wire Sizes” page 67.

Note: For crimp and seal repairs, use only splice or terminal connections with heat shrink covering. If non-heat shrink connectors are used, a separate piece of heat-shrink tubing must be used to seal the connection.

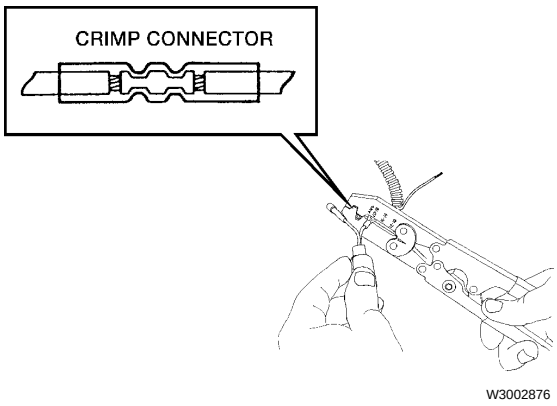

W3002878

1
Remove wiring insulation approximately 10 mm (3/8 inch) from the end of the wire.



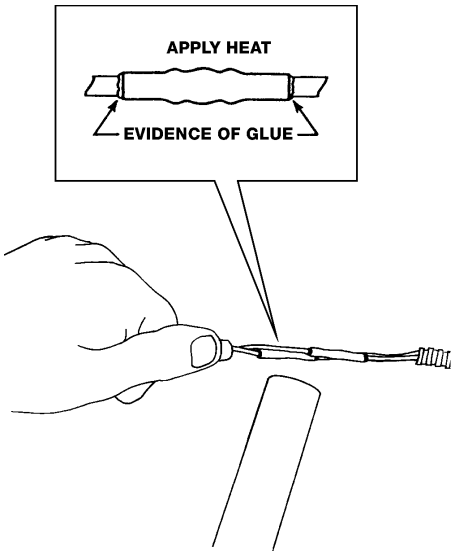
W3002875

2
Determine the proper size splice connector for the wire being repaired. Install each end of the wire into the splice until the wire hits the stop.



W3002876

3
Insert the connector into the proper anvil on the crimping tool and crimp. Gently tug on the spliced connection to be sure the wire is secure.



W3002877

4
Heat the splice connector to activate the heat shrink. Look for sealant at each end of the connector as evidence of a good application.

Note: Do not use an open flame to apply heat shrink.

JAE Terminal, Replacement

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

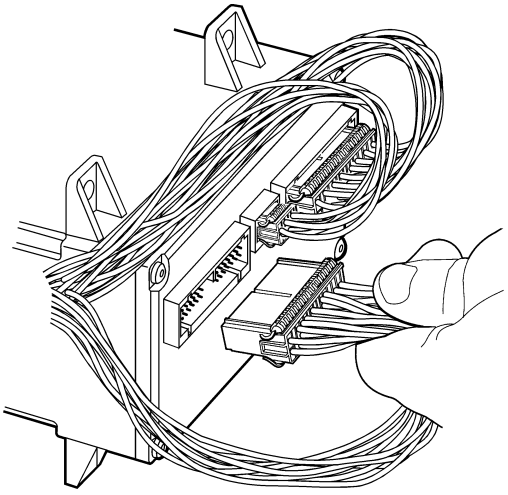
JAE connectors are used on the Vehicle ECU (VECU) and on the instrument cluster. To replace faulty terminals in these connectors use the butt splice connectors listed below (available from Volvo):

- 3948725 (for black, numbered wires)
- 3978726 (for ground wires)

Special tools: 3949522, J-42449, J-38125-8, J-25070

Removal

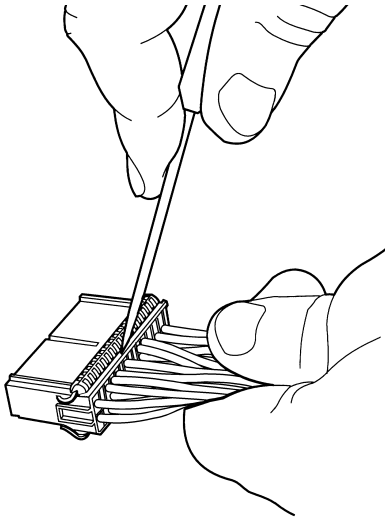
1
Disconnect the JAE connector with the faulty terminal from the component.



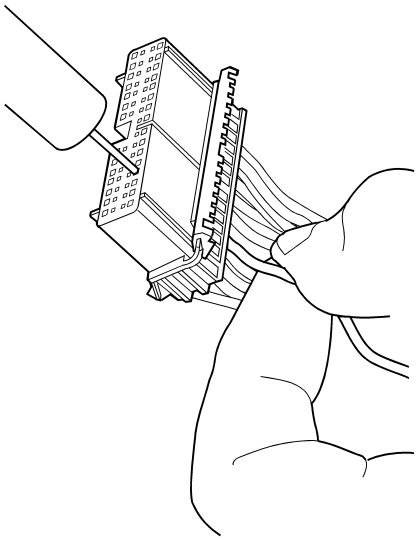
W3002865

2
Carefully pry open the lock on the male portion of the connector using a small flat screwdriver.

Note: The lock is not easy to see. To open the lock, pry just under the top ledge of the connector (see figure).



W3002866



W3002867

3
Remove the faulty terminal from the connector as follows, using the removal tool from kit J-42449.

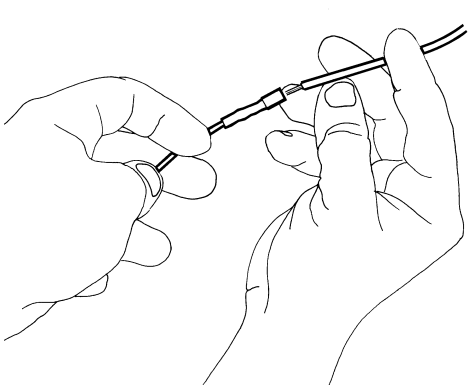
Note: In each of these JAE connectors there are two rows of terminals, and two rows of release holes. The release holes are the two outside rows.

Insert the removal tool into the release hole above the terminal being removed. It will take some pressure to make the terminal locks release.

J-42449

Installation

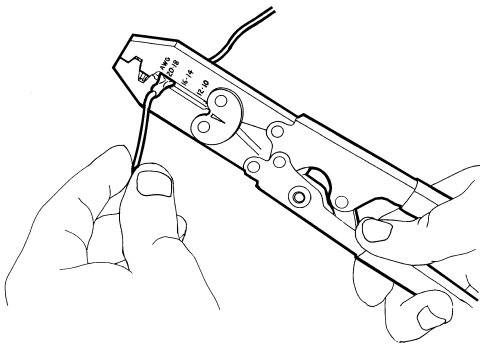
1
Cut the faulty terminal wire to the same length as the JAE terminal pigtail replacement.



W3002868

2
Strip the insulation back approximately 6 mm (1/4 in.) and install butt splice 3948725 (or 3948726) to the wire.

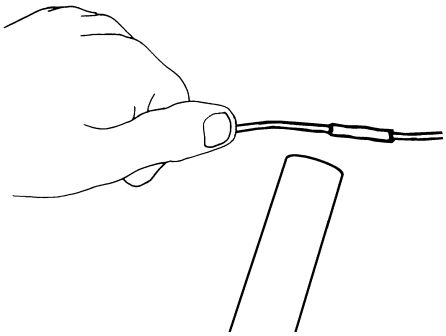
3948725
, 3948726



W3002869

3
Crimp in the 18-20 anvil of crimper J-38125-8 (from Repair Kit 3947553). Slightly pull the wire to ensure a correct crimp.

J-38125-8



W3002870

4
Using heat gun J-25070 (or equivalent tool), heat the splice to shrink the tubing until the adhesive is visible for a good moisture seal.

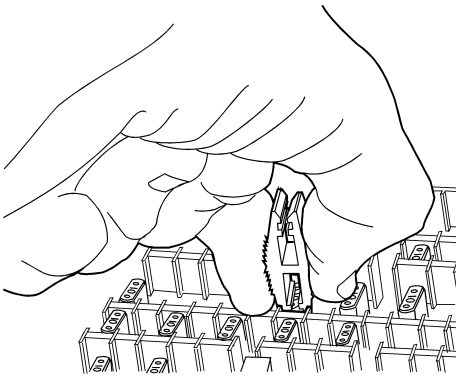
J-25070

5
Install the terminal into the correct connector cavity. Pull back on the wire to make certain the terminal is locked into the connector. Push the connector lock back into position.

6
Connect the connector to the component and check for proper function.

Mini-fuse, Replacement

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.



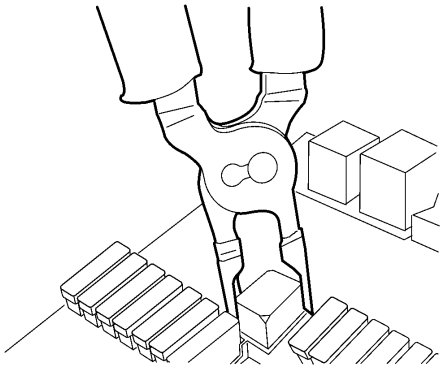
W3002525

1
To replace mini-fuses in the truck electrical center, use only the fuse puller tool provided with the vehicle, 20378326. Removing the mini-fuses with another device can possibly damage the connections.

20378326

Relay, Replacement

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.



T3019610

1

To replace relays, use relay puller tool J-43244. This tool can be used on standard size or micro-relays, power relays, mini-circuit breakers, maxi-fuses, etc.

J-43244

3714-03-02-02
Fusible Link, Replacement (Battery Side)

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

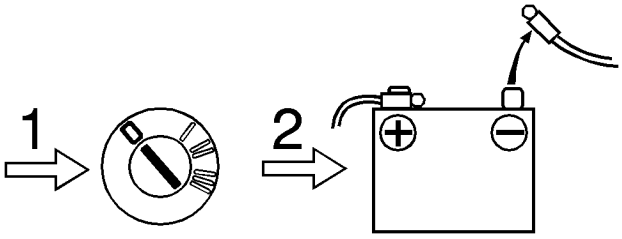
Removal

Note: If a battery side fusible link becomes an open circuit, power will not be supplied to the cab power stud on that circuit (no continuity between the cab stud and starter solenoid).

1

CAUTION

Check the electrical system for a short circuit before beginning this procedure to prevent another fusible link from melting. Failure to repair the short circuit which caused the fusible link to melt will result in the new fusible link melting.

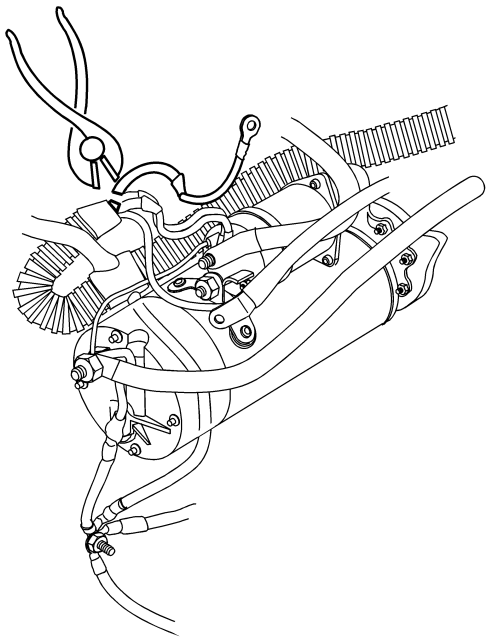


T8006862

2
Turn the ignition key OFF and disconnect the negative and positive battery cables.

3
Remove the cable mounting nut from the bulkhead pass-through plate. Since there are two fusible links, check the continuity in the fusible link wire to make sure you are replacing the one that has melted. After locating the correct one, cut the wire as close as possible to the wiring harness conduit and tape to prevent future use.

4
Loosen the bolt that goes through the battery cable clamping bracket. Remove the cable from the clamp. This will allow the cable to be removed from the solenoid.



W3002564

5
Remove the nut from the starter solenoid post where the fusible link/main battery cable is attached. The melted fusible link should be noticeable. If not, check continuity to find the faulty fusible link. Cut the melted fusible link wire as close as possible to the wiring harness conduit and tape to prevent future use.

Installation

1
Install the new fusible link by installing the eye terminal onto the bulkhead pass-through stud. Position the eye terminal with the wire down. Tighten the pass-through stud nut to 10 ± 2 Nm (88 ± 18 in-lb). Install the insulator cap.

10 ± 2 Nm
(88 ± 18 in-lb)

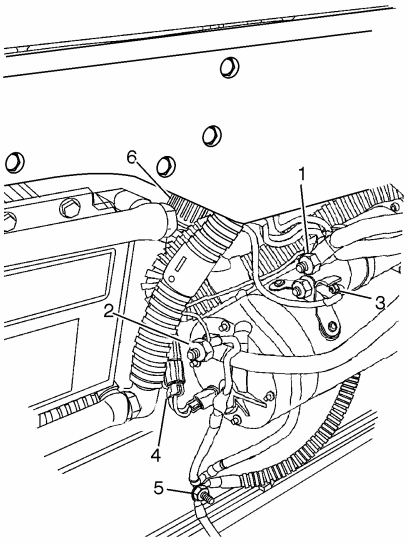


Fig. 76: Delco 42MT Starter

1 Positve Cable
2 Negative Cable
3 Ignition Switch Terminal
4 Overcrank Switch Connector
5 Engine Ground
6 Engine Harness

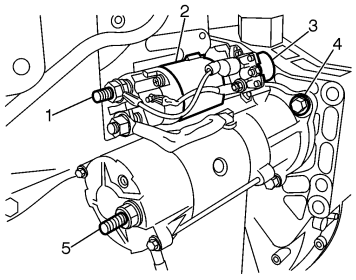


Fig. 77: Gear Reduction Starter

1 Positve Stud
2 Starter Solenoid
3 Starter Relay
4 Mounting Bolt
5 Ground Stud

2

Route the new fusible link along the engine wiring harness. Install the fusible link onto the starter solenoid stud, along with the other terminals that were connected before. Tighten the starter solenoid stud nut as follows:

- Delco 42MT — 30.5 ± 3.5 Nm
(22 ± 2.6 ft-lb)
- Gear Reduction — 25 ± 5 Nm
(18 ± 3.7 ft-lb)

Tie strap the new fusible link to the engine harness, making sure to trim the extra tie strap ends.

30.5 ± 3.5 Nm
(22 ± 2.6 ft-lb), 25 ± 5 Nm
(18 ± 3.7 ft-lb)

3

Install the cable into the battery cable clamping bracket. Tighten the bolt on the bracket to 17 ± 3 Nm (150 ± 27 in-lb).

17 ± 3 Nm
(150 ± 27 in-lb)

4

DANGER

Personal injury risk. In vehicles with SRS Airbags, make sure that no one is inside the cab when connecting the battery. Otherwise, serious personal injury could occur due to possible deployment of the airbag.

Connect the battery positive and negative cables, connecting the positive cable first. Tighten nuts to 24 ± 4 Nm (212 ± 35 in-lb).

3714-03-02-01
Fusible Link, Replacement (Ground Cable)

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

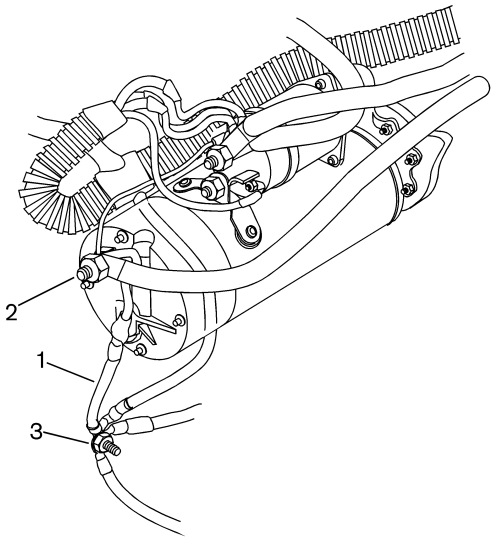
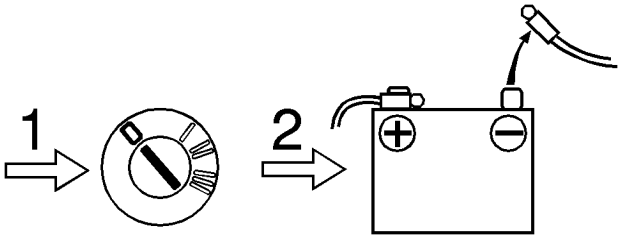


Fig. 78: Delco 42 MT (shown)

1 Ground Side Fusible Link
2 Starter Ground Stud
3 Engine Ground (location varies by engine)

Removal

1
To verify ground fusible link failure, check for a visible break in the fusible link (1).



2

CAUTION

Since the ground side fusible link protects the battery and battery cable, check the electrical system for a short circuit before beginning this procedure to prevent another fusible link from melting. Failure to repair the short circuit which caused the fusible link to melt will result in the new fusible link melting.

3
Turn the ignition key OFF and disconnect the negative and positive battery cables.

4
Loosen the bolt on the battery cable clamping bracket. This will allow the negative battery cable to be removed.

5
Remove the nut from the ground stud at the starter solenoid, and remove the fusible link terminal from the starter.

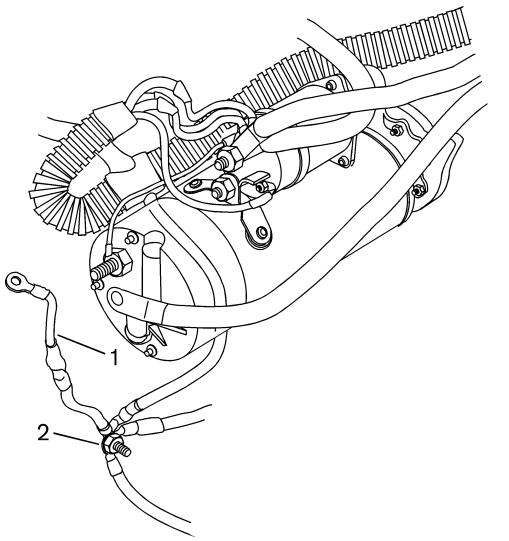
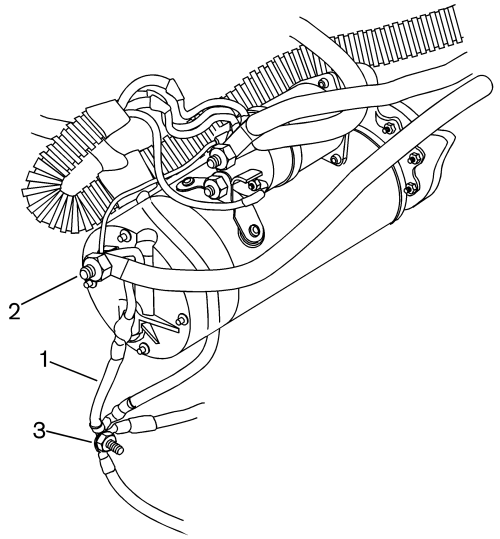


Fig. 79: Delco 42 MT (shown)

1 Fusible Link Removed
2 Engine Ground Stud
(Note: location varies by engine)

6
Remove the nut on the side of the engine block where the fusible link is connected, and remove the fusible link from the vehicle.



1 Ground Side Fusible Link
2 Starter Ground Stud
3 Engine Ground (location varies by engine)

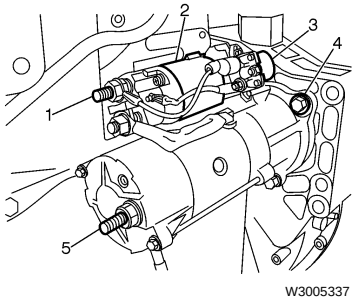


Fig. 80: Gear Reduction Starter

1 Positve Stud
2 Starter Solenoid
3 Starter Relay
4 Mounting Bolt
5 Ground Stud

Installation

1

Install the fusible link terminal and negative battery cable at the starter ground stud. Install the nut and tighten as follows:

- Delco 42MT — 30.5 ± 3.5 Nm (22 ± 2.6 ft-lb)
- Gear Reduction — 25 ± 5 Nm (18 ± 3.7 ft-lb)

30.5 ± 3.5 Nm
(22 ± 2.6 ft-lb), 25 ± 5 Nm
(18 ± 3.7 ft-lb)

2

Install the new fusible link cable assembly at the engine block. Tighten the nut to 19 ± 4 Nm (168 ± 35 in-lb).

19 ± 4 Nm
(168 ± 35 in-lb)

3

Install the battery cables into the clamping bracket. Tighten the bolt on the clamping bracket to 17 ± 3 Nm (150 ± 27 in-lb). Connect the battery cables into the clamp bracket. Tighten the bolt to 23 Nm (203 in-lb).

17 ± 3 Nm
(150 ± 27 in-lb)
, 23 Nm
(203 in-lb)

4

DANGER

Personal injury risk. In vehicles with SRS Airbags, make sure that no one is inside the cab when connecting the battery. Otherwise, serious personal injury could occur due to possible deployment of the airbag.

Connect the battery positive and negative cables, connecting the positive cable first. Torque nuts 24 ± 4 Nm (212 ± 35 in-lb).

3341-03-02-01
Ignition Switch, Replacement

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

Removal from Locking Housing

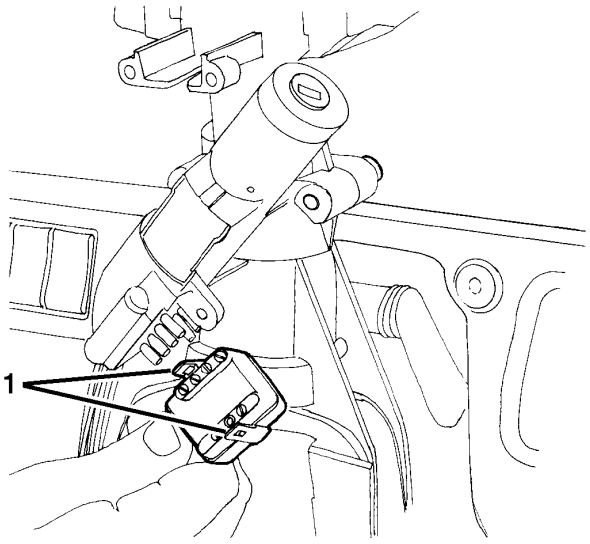
1
Turn the ignition key ***OFF***.

2
Remove the 2 clips at the bottom of the steering column cover.

3
Adjust the steering column up and toward you, where possible. Remove the front steering column cover by removing the 3 torx bolts from the cover and sliding the rubber grommets off of the cover at the stalk switches.

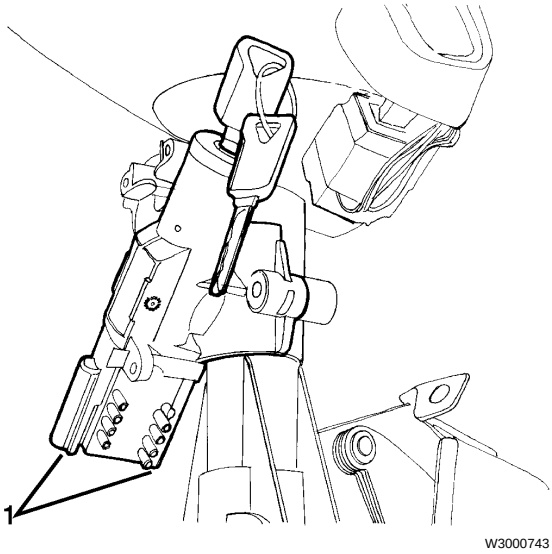
4
Adjust the steering column forward and up where possible. Remove the 1 torx bolt from the rear column cover and remove cover.

5
Disconnect the ignition switch electrical connector by carefully depressing clips on each side of connector.



W3001001

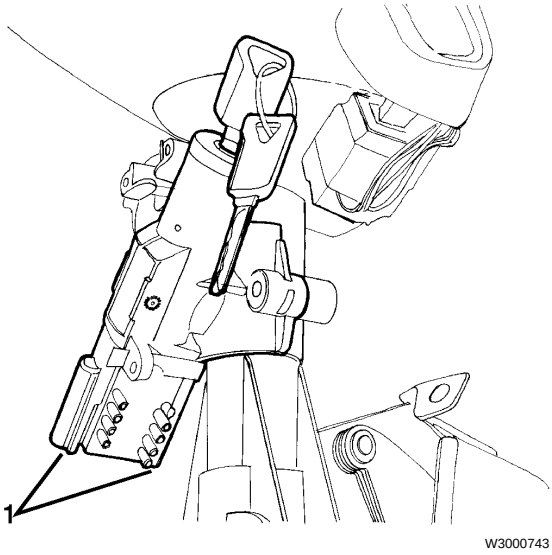
1 Locking Clips



1 Machine Screws

6
Remove the 2 machine screws on the left and right side of the ignition switch and remove the switch from its housing.

Installation into Locking Housing



1 Machine Screws

1
Place switch into locking housing, aligning slots on switch and housing shaft. Holding switch in place, start both screws before tightening. Tighten to 1.7 ± 0.5 Nm (15 ± 4 in-lb).

1.7 ± 0.5 Nm
(15 ± 4 in-lb)

2
Connect the ignition switch electrical connector.

3
Pull steering column back and up, where possible. Install front cover by installing torx bolts. Tighten to 5 ± 0.8 Nm (44 ± 7 in-lb).

5 ± 0.8 Nm
(44 ± 7 in-lb)

4
Adjust the steering column forward and up, where possible. Install the rear cover of the steering column by installing torx bolt and attaching rubber grommets at the stalk switches. Tighten bolt to 5 ± 0.8 Nm (44 ± 7 in-lb).

5 ± 0.8 Nm
(44 ± 7 in-lb)

5
Replace the 2 clips on the bottom of the steering column cover.

3341-03-02-02
Ignition Switch and Housing, Replacement

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

Removal

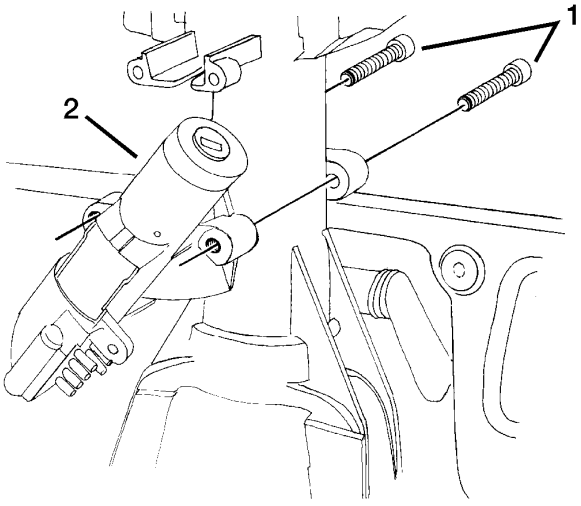
1
Turn the ignition key ***OFF***.

2
Remove the 2 clips at the bottom of the steering column cover.

3
Adjust the steering column up and toward you, where possible. Remove the front steering column cover by removing the 3 torx bolts from the cover and sliding the rubber grommets off of the cover at the stalk switches.

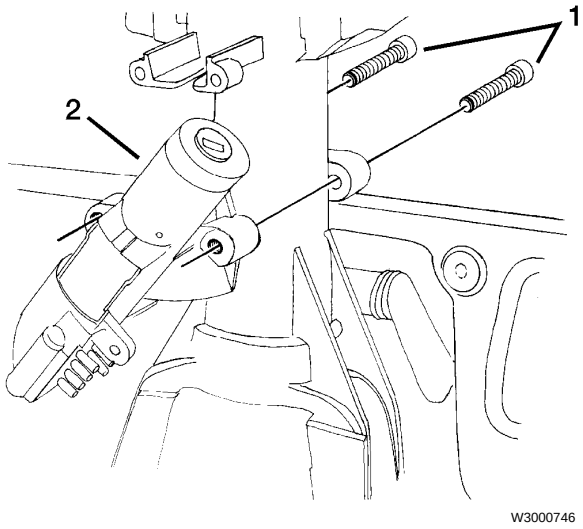
4
Adjust the steering column forward and up, where possible. Remove the 1 torx bolt from the rear column cover and remove cover.

5
Disconnect the ignition switch electrical connector. Remove the 2 allen bolts from the forward side of the ignition switch housing to remove switch and housing.



W3000746

1 Bolts
2 Switch and Housing Assembly



1 Bolts
2 Switch and Housing Assembly

Installation

1
Mount the switch and housing on the steering column with the 2 bolts. Tighten to 24 ± 4 Nm (18 ± 3 ft-lb).

24 ± 4 Nm
(18 ± 3 ft-lb)

2
Connect the ignition switch electrical connector.

3
Adjust the steering column forward and up, where possible. Install the rear cover of the steering column. Torque bolts to 5 ± 0.8 Nm (44 ± 7 in-lb).

5 ± 0.8 Nm
(44 ± 7 in-lb)

4
Adjust the steering column up and toward you, where possible. Install front cover by installing torx bolt and attaching rubber grommets at stalk switches. Tighten bolt to 5 ± 0.8 Nm (44 ± 7 in-lb).

5 ± 0.8 Nm
(44 ± 7 in-lb)

5
Replace the 2 clips on the bottom of the steering column covers.

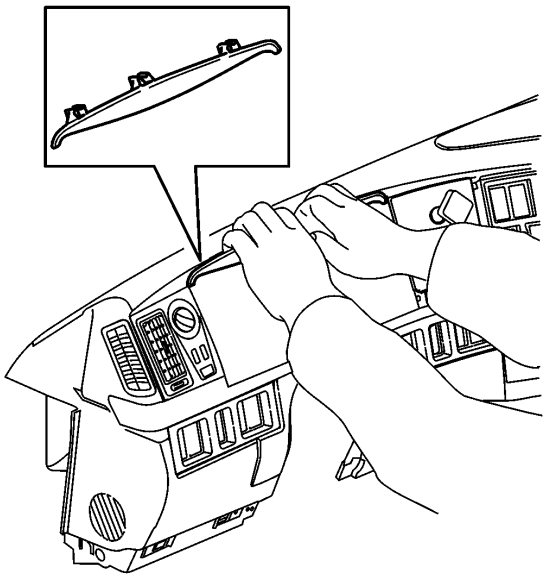
3646-03-02-46
Light Control Panel, Replacement

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

Removal

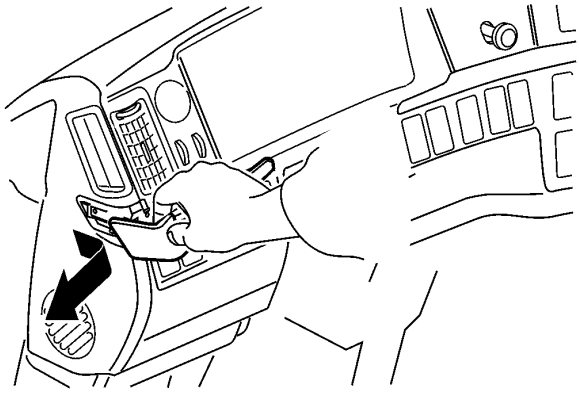
1
Turn the ignition key ***OFF***.

2
Remove the dash trim piece above the instrument cluster.

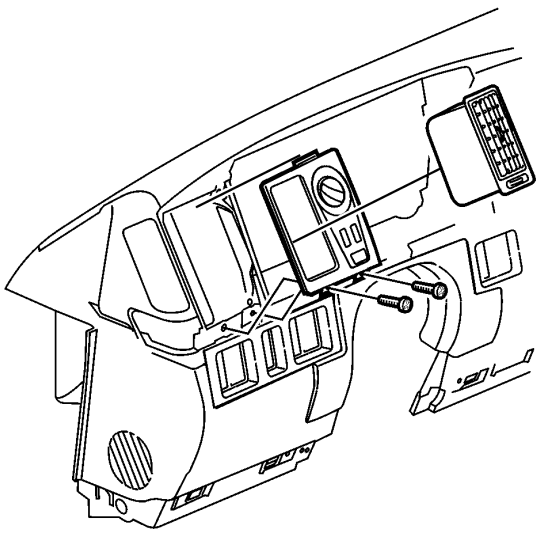


W8003307

3
Remove the dash trim piece below the LCP.



T8009004



W8003308

4
Remove the left window vent register.

5
Remove the 2 torx bolts that retain the LCP and the left face vent trim panel.

Note: It may be easier, for removal and installation, to pop out the left face vent.

6
Pull the panel out of the dash and disconnect the wiring from the LCP.

7
Squeeze the locking tabs on the left side of the switch, releasing left side.

8
Squeeze the locking tabs on the right side of the switch. remove the switch from the trim panel.

Installation

1
Install the new LCP into the trim panel.

2
Connect the electrical connector on the LCP.

3
Install the trim panel and tighten the 2 torx bolts to 5 ± 0.8 Nm (44 ± 7 in-lb).

4
If removed, install the left face vent.

5
Install the left window vent register.

6
Install the dash trim below the LCP and above the instrument cluster.

7
Check for proper operation of the LCP.

3643-03-02-01
Turn Signal/CC Switch Assembly, Replacement

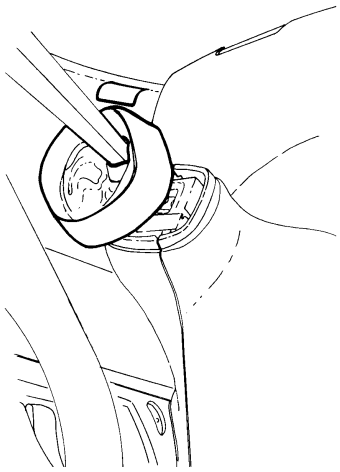
You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

Removal

1
Turn the ignition key ***OFF***.

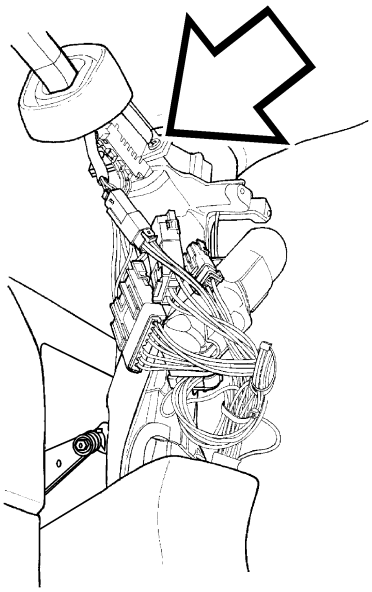
2
Remove the 2 clips at the bottom of the steering column cover.

3
Adjust the steering column up and toward you, where possible. Remove the front steering column cover by removing the 3 torx bolts from the cover and sliding the rubber grommets off of the cover.



W3000653

4
Push the steering column forward and up, where possible. Remove the 3 torx bolts from the rear column cover and remove cover.



W3000643

5
Disconnect all electrical connections for turn signals, cruise, and headlamp dimmer switch. Remove the 2 torx bolts on the sides of the switch and remove switch.

Installation

1
Mount the switch assembly to steering column with the 2 bolts and connect all electrical connectors. Tighten bolts to 5 ± 0.8 Nm (44 ± 7 in-lb).

5 ± 0.8 Nm
(44 ± 7 in-lb)

2
Pull steering column back and up, where possible. Install front cover by installing torx bolts. Tighten bolts to 5 ± 0.8 Nm (44 ± 7 in-lb).

5 ± 0.8 Nm
(44 ± 7 in-lb)

3
Push the steering column forward and up, where possible. Install the rear cover of the steering column by installing torx bolts and attaching rubber grommets at the stalk switches. Tighten bolts to 5 ± 0.8 Nm (44 ± 7 in-lb).

5 ± 0.8 Nm
(44 ± 7 in-lb)

4
Install the 2 clips on the bottom of the steering column cover.

3646-03-02-33
Back of Cab Lamp Switch, Replacement

For a complete description of this procedure, see “Dash Switch/Auxiliary Switch, Replacement” page 96.

3646-03-02-35
PTO Switch, Replacement

For a complete description of this procedure, see “Dash Switch/Auxiliary Switch, Replacement” page 96.

3646-03-02-36
Bunk Overhead Lamp Switch, Replacement

For a complete description of this procedure, see “Dash Switch/Auxiliary Switch, Replacement” page 96.

3646-03-02-37
Headlamp Interrupt Switch, Replacement

For a complete description of this procedure, see “Dash Switch/Auxiliary Switch, Replacement” page 96.

3646-03-02-38
Snowplow Lamp Switch, Replacement

For a complete description of this procedure, see “Dash Switch/Auxiliary Switch, Replacement” page 96.

3646-03-02-39
Smoke Detector Disable Switch, Replacement

For a complete description of this procedure, see “Dash Switch/Auxiliary Switch, Replacement” page 96.

3646-03-02-24
Marker Interrupt Switch, Replacement

For a complete description of this procedure, see “Dash Switch/Auxiliary Switch, Replacement” page 96.

3646-03-02-40
Engine/Exhaust Brake Switch, Replacement

For a complete description of this procedure, see “Dash Switch/Auxiliary Switch, Replacement” page 96.

3646-03-02-41
Traction Control Switch, Replacement

For a complete description of this procedure, see “Dash Switch/Auxiliary Switch, Replacement” page 96.

3646-03-02-26
Heated Mirror Switch, Replacement

For a complete description of this procedure, see “Dash Switch/Auxiliary Switch, Replacement” page 96.

3646-03-02-42
Lift Axle Switch, Replacement

For a complete description of this procedure, see “Dash Switch/Auxiliary Switch, Replacement” page 96.

3646-03-02-43
Beacon Lamp Switch, Replacement

For a complete description of this procedure, see “Dash Switch/Auxiliary Switch, Replacement” page 96.

Dash Switch/Auxiliary Switch, Replacement

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

The same procedure is used to replace all dash and optional (auxiliary) switches. The dash switches may include Marker Interrupt, Engine Brake, Traction Control, ect. Optional or auxiliary switches are used for additional customer requested components, such as lift axle or beacon lights.

Removal

1
Turn the ignition key ***OFF***.

2
Insert a No. 1 flat tip screwdriver into the bottom of the switch to release the locking tab.

3
The switch will rock out at the bottom. Pull the switch down from the top and out.

4
Disconnect the electrical connector of the switch being removed.

Installation

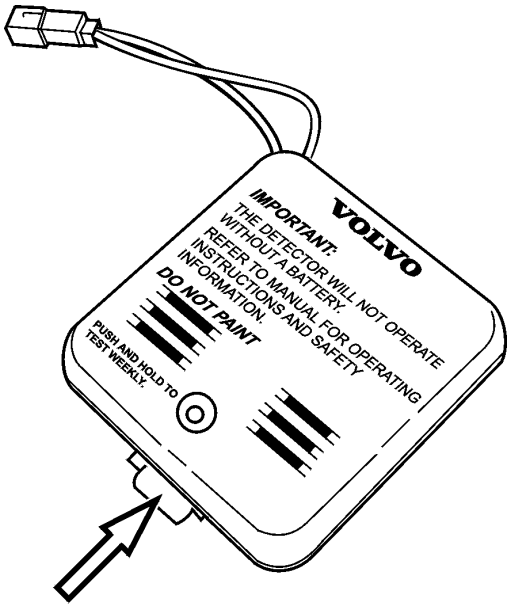
1
Connect electrical connection on switch.

2
Install the new switch, pushing the switch into the panel until it locks. Push back on the switch to make certain it is locked in the panel.

3663-03-02-01
Smoke Detector/Battery, Replacement

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

Removal

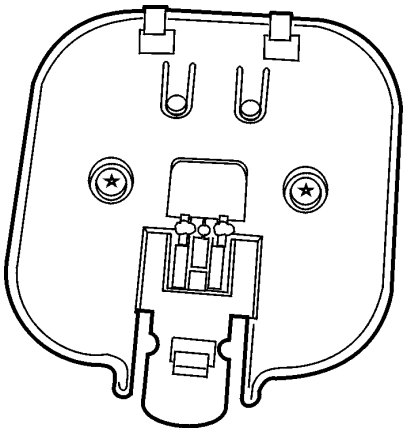


W8002732

1
To remove the smoke detector from the mounting base, press the release tab up. With the smoke detector removed, the 9–volt battery can be replaced.

2
To remove the mounting base, remove the two mounting screws and disconnect the connector.

Installation



W8002734

1
Connect the connector to the replacement mounting base and install with the two screws.

2
Check that a known good 9–volt battery is installed in the smoke detector. Snap the smoke detector into the mounting base. Be sure the release tab is locked into position.

3
Test the smoke detector for proper operation by pressing the function button/indicator light for 5 seconds. If the battery is OK the alarm should sound as long as the button is pressed.

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